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ABSTRACT

Contrary to a major statistical series calculated by the U.S. Bureau of Economic Analysis, the Gross Product Originating (GPO) series, the United States has experienced a definite erosion of its industrial base between 1973 and 1985, with manufacturing dropping at least 2.8 percent and perhaps as much as 4.5 percent in its share of national output. Manufacturing labor productivity growth from 1979-85 was about 1.9 percent annually rather than the 3.5 percent growth implied by the GPO series. That growth rate is only 60 percent that of other industrialized countries. The GPO series' reliability is suspect for the following reasons, among others: (1) the series' statements imply that imported components and service sector outsourcing decreased during this period, whereas all evidence shows that it rose; (2) large adjustments made to the 1972-74 data critically distort the historic trends, accounting for 40 percent of purported manufacturing output growth in the 1973-83 period; (3) given the input-output data, the series has been overstating the growth of manufacturing value-added; and (4) the series' reliance on price changes for only domestically produced goods leads to a systematic overstatement of constant dollar value-added growth during periods of large increases in imports. (The document includes four appendices and a four-page bibliography.) (CML)

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How Inaccurate Statistics Conceal U.S. Industrial Decline

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MANUFACTURING NUMBERS:

How Inaccurate Statistics Conceal U.S. Industrial Decline

By Lawrence Mishel

Preface by John R. Norsworthy

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Lawrence Mishel is the Research Director of the Economic Policy Institute. Dr. Mishel holds a Ph.D. in economics from the University of Wisconsin. Prior to working at the EPI, Dr. Mishel served as an economist for a variety of labor organizations, including the Industrial Union Department (AFL-CIO) and the United Auto Workers and was an assistant professor at Cornell University. Dr. Mishel has published articles in a variety of academic and non-academic journals.

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Preface

By John R. Norsworthy*

Dr. Mishel raises very important points in this report concerning the meaning of the industry output data in the National Income and Products Accounts, (NIPA) and of GNP-type measures of output at the industry level. These industry output data are critical since they are the basis of our knowledge of manufacturing productivity trends and of manufacturing's share of national output. Mishel's analysis shows that manufacturing output growth has been seriously overstated by the Bureau of Economic Analysis (BEA). This, in turn, leads to an overstatement of manufacturing productivity growth and an understatement of the shrinkage in manufacturing's share of total output. These findings suggest that the manufacturing sector has not been as healthy as many analysts, relying on these official data, have contended.

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* John R. Norsworthy is currently a professor of Economics at the Rensselaer Polytechnic Institute. He formerly served as chief of the BLS Productivity Research Division and as chief of the Census Bureau Center for Economic Studies.

The challenge of Dr. Mishel's critique for the BEA is to respond openly and constructively, rather than close the ranks and claim that yet another of the uninitiated has misunderstood. For Dr. Mishel has done his homework here; he is one of the few people acquainted with the detailed issues that arise in constructing the product side of the accounts and he is anything but a hatchet man.

Unfortunately, the technical issues raised by this report cannot be independently resolved. Much of the data upon which the NIPA are based are not publicly available, and they are manipulated by methods that are nowhere spelled out in sufficient details.

Given the wide use of these data in critical public debates over economic policy, the publication of this report makes it imperative that the BEA fully publish its methods and procedures. True, federal statistical programs these days are under annual siege by budget cutters. But that makes it so much more urgent to open the books. For agencies such as the Bureau of Labor Statistics and the Bureau of the Census that routinely publish their methods and review them with professional peer committees, the effects of possible budget costs on the quantity and quality of economic statistics are relatively easy to assess. For the National Income and Products Accounts, it is far more difficult to assess the quality change due to budget costs because budget cuts seem to be BEA's reason to publish <u>less</u> information about already obscure methods. Those of us who are avid users of

national economic statistics strongly favor improved and expanded economic measurement programs; we would be less than human if we did not prefer and support programs whose quality we understand over those whose methods are obscure.

In any event, Dr. Mishel has done those of us who care about the quality of the nation's statistics, as well as those of us concerned about the policy uses to which such statistics are put, a major service with this excellent report.

Troy, New York
April 1988

Manufacturing Numbers: How Inaccurate Statistics Conceal U.S. Industrial Decline

Executive Summary

The health of the U.S. manufacturing sector has been the subject of controversy among economists and confusion among policymakers and the general public over the last several years. Many economic indicators such as jobs lost, plant shut-downs, a burgeoning trade deficit, and lagging manufacturing investment point to an erosion of our industrial base.

On the other hand, a major statistical series calculated by the Commerce Department's Bureau of Economic Analysis, the Gross Product Originating (GPO) series, suggests that manufacturing has maintained its historical share of national output. Relying on the GPO series, a number of policymakers and economists have argued that the shrinkage of manufacturing employment is a positive sign, reflecting relatively faster productivity growth in the manufacturing sector. Therefore, policies designed to reinvigorate the manufacturing sector are not warranted.

This report concludes that the GPO series is an unreliable indicator of manufacturing output trends. The study finds that,

contrary to the trends in output and productivity described by the GPO series:

* The U.S. has experienced a definite erosion of its industrial base between 1973 and 1985, with a more rapid deterioration since 1979. Manufacturing's share of national output was 22.9 percent in 1973 and dropped at least 2.8, and perhaps as much as 4.5 percentage points by 1985.
* The shrinkage of manufacturing employment is equally due to relatively slower output growth and to relatively faster manufacturing productivity growth. The employment shrinkage due to lost output cost nearly 2 million jobs in 1985.
* Manufacturing labor productivity growth from 1979 to 1985 was about 1.9 percent annually rather than the 3.5 percent growth implied by the GPO series.
* The 1.9 percent growth rate represents an improvement over the lagging productivity trends of the mid-70s but is only 60 percent of that of other industrialized countries.
* This lower estimate of manufacturing labor productivity implies that non-manufacturing productivity from 1979 to 1985 advanced by 0.7 percent annually, faster than the official estimate of just 0.1 percent.

The GPO series' reliability is suspect on four grounds:

1. According to the GPO series, constant dollar gross output rose just 2 percent from 1979 to 1985 while constant dollar value-added rose more than six times faster. This increase in

"value-added intensity" implies that during this period there was a decrease in the proportion of final manufacturing products represented by imported components and/or decreased outsourcing of manufacturing activity to the service sector. Yet all evidence tells us that imported components and service sector outsourcing rose during this period.

2. Large adjustments made to the 1972-74 data critically distort the historic trends. These adjustments artificially reduced manufacturing output in the GPO series by over 8 percent in 1973 and consequently overstate the growth of manufacturing output growth between 1973 and later periods. These adjustments account for some 40 percent of purported manufacturing output growth in the 1973-85 period.

3. A comparison of the GPO data with Input-Output data suggests that the GPO series has been overstating the growth of manufacturing value-added. For example, manufacturing value-added growth from 1972 to 1981 according to the GPO series is nearly double the growth implied by Input-Output data. The trends since the last full "benchmarking" in 1977 are the most troublesome. This suggests that there will be a major downward revision in the estimate of manufacturing as a result of the next benchmarking of the GPO series (with 1982 data).

4. Historical series such as the GPO data which have been "deflated" with price indices are very sensitive to the choice of the base period (i.e., the year in which the index is 100). All assertions about manufacturing's historically constant share of

output need to be treated with caution since selection of a recent base period, as in the GPO series, systematically understates manufacturing's relative importance in the past.

Among the most important technical reasons for the overstatement of manufacturing growth by the GPO series are:

* The GPO series only measures price changes of domestically produced goods. During a period of large increases in imports, the exclusion of import prices for components and other inputs leads to a systematic overstatement of constant dollar value-added growth.
* The difficulty in assigning fringe benefits, profits, and depreciation to the proper sector. Significant changes in ownership (mergers, acquisitions, diversification), increased corporate debt and an increase in the relative importance of fringe benefits are probably leading to an understatement of the GPO's measurement of manufacturing input growth and a consequent overstatement of value-added growth.

Manufacturing Numbers: How Inaccurate Statistics Conceal U.S. Industrial Decline

1. Introduction

Throughout the 1980s, economists and policy-makers have faced what appears to be contradictory evidence on whether the American economy has been "deindustrializing," i.e., losing its manufacturing base.

There are many indications that the manufacturing sector contracted in the 1980s. There was considerable job loss: more than 5 million manufacturing workers permanently lost their jobs in plant closings and lay-offs between 1981 and 1985. Sales stagnated: from 1979 to 1985 manufacturing sales (in constant 1982 dollars) grew 0.4 percent annually, far less than the 2.1 annual growth in the prior six years. Investment also lagged: the manufacturing capital stock (net fixed) grew at a 3.5 percent pace in the 1973-79 period but rose at only half that rate from 1979 to 1985.[1] Increases in the demand for goods accelerated 30 percent in the 1979 to 1985 period over the rise in the 1973 to 1979 period; yet, the growth of domestic goods production did not accelerate.[2]

These indicators of an eroding industrial base parallel the deterioration of our international trade position. Between 1973 and 1979 imports of non-petroleum merchandise rose 25 percent while exports rose 36 percent, yielding a $22 billion improvement in the trade balance. In contrast, from 1979 to 1985 imports raced ahead 78 percent while exports grew by only 6 percent. The result was a $124 billion deterioration in our non-petroleum merchandise trade balance.[3]

In addition to statistical data, anecdotal indicators of decline and shrinkage in industry after industry has been reported steadily in the newspapers and business press throughout the 1980s. Industrial decline and competitive problems have become a major subject of concern among business, labor, and academic analysts of the economy.

But the wealth of evidence that America is deindustrializing appears to contradict another set of apparent "facts" based on a statistical series published by the U.S. Department of Commerce's Bureau of Economic Analysis entitled Gross Product Originating (GPO). This series attempts to measure real GNP by industry sector (manufacturing, construction, services, and so on). According to this series manufacturing output has <u>not</u> declined relative to the overall economy since 1973. Some policymakers and economists have interpreted this as conclusive evidence that manufacturing has held its own. They argue further that manufacturing employment shrinkage is a positive sign reflecting fast manufacturing productivity growth, not an eroding industrial

base.[4] At best, therefore, the only manufacturing "problem" is the need to help workers displaced by this productivity growth.

Thus, according to the 1988 Economic Report of the President of the Reagan Council of Economic Advisors:

> Except for business cycle movements, the share of real manufacturing output and real final goods output have been remarkably stable for 25 years....While manufacturing's share of employment has declined....this trend does not suggest any long-term weakness in the manufacturing sector. Instead, it reflects stronger productivity growth in manufacturing than in other sectors of the economy.[5]

Robert Z. Lawrence [1987] of the Brookings Institution argues the same point:

> The estimate of manufacturing output in the GNP accounts shows America is not deindustrializing -- either over the long run (1960 to 1985) or the medium run (1980 to 1985). Real value-added in American manufacturing (measured in 1982 dollars) constituted 20.4 percent of GNP in 1980 and 21.7 percent of GNP in 1985. The volume of U.S. manufactured goods production has thus kept pace, almost exactly, with the overall production of goods and services (the GNP)....Faster productivity growth in goods production (rather than slower demand) is the source of the declining share of industrial employment in the economy.

Appendix A presents an additional sampling of this general point of view. <u>What provides unity to these analyses is that they are based solely on the GPO data series</u>.

The proposition that manufacturing's share of the economy has <u>not</u> declined presents us with several puzzles. For example, the GPO series suggests that the manufacturing share of output was unaffected by the relative decline in sales, investment and

employment as well as by a mass of anecdotal information on the shrinkage of manufacturing capacity. The GPO data also suggest that U.S. manufacturing has held its own, despite a massive deterioration of our international trade position. Yet, during this same period positive trade developments in Japan led to a significant increase in manufacturing's share of national output. As Japan's net external trade balance shifted from a negative 4.4 percent to a positive 4.2 percent of national output between 1979 and 1985, the manufacturing sector's share of output rose from 28 to 35 percent. How is it that the sharp swings in the merchandise trade deficit had such a dramatic impact in Japan but no impact on manufacturing's share in the U.S.?[6]

Given these contradictions and puzzling implications of the most widely used measure of manufacturing's share, it is time to subject the GPO series to more rigorous scrutiny to assure that the data properly reflect the economic reality they are intended to describe.

2. Measures of Manufacturing Output

Federal statistical agencies provide two measures of annual physical production in each American industry. One measure is called gross output, a measure reflecting the quantity of manufacturing products produced in an industry's U.S. facilities. Gross output is based on data collected by the Census Bureau in surveys of manufacturing shipments. Since gross output is supposed to measure productive activity, not just sales, the numbers for each industry are adjusted to incorporate year to year changes in inventory levels. These data are then "deflated" by price indices to eliminate the effect of pure price changes. The result is a statistical series which reflects annual changes in "real" or constant dollar gross output, i.e., the changes in the quantity of autos, steel, chemicals, lumber, machinery, and other manufactured products actually produced in domestic manufacturing facilities.

The second measure of physical production is "value-added," a net output measure which shows the difference between gross output of U.S. manufacturing facilities and the quantity of the physical inputs (raw materials, energy, supplies) used up in the production process. Value-added attempts to measure, literally, the value each industry has added to the output it purchased from other industries or from overseas. As an analytical tool value-added has the advantage of being more comprehensive than a gross

output measure. For example, assume that a U.S. factory has the same gross output in two different years but that in the second year it purchases some components from abroad that it previously assembled itself. Moreover, for simplicity, assume that there was the same amount of labor and capital input in each year. A gross output measure of output would indicate that the industry's economic activity was at the same level in both years. This result is clearly inaccurate because in the earlier year the industry did the additional work of assembling the components it simply purchased in the latter year. As a result, value-added is, in theory, a more refined measure of an individual firm's "output".

But both gross output and value-added measures reflect important dimensions of economic activity. Gross output data tell us the changes in the amount of manufactured products created domestically. Manufacturing value-added data tell us the degree to which manufacturing establishments have added value to the inputs obtained from other industries.[7]

In practice, however, value-added also has some disadvantages as a measure of output. One is that certain stringent economic assumptions have to hold for value-added to be a correct measure of output trends.[8] And, as research by J.R. Norsworthy and David Malmquist (at the time, respectively, chief economist at the Bureau of Census Center for Economic Studies and economist at the Securities Exchange Commission) has shown, these economic assumptions do not hold for U.S. manufacturing

production. Norsworthy and Malmquist [1983, p.952] conclude:

> Consequently, a value-added measure of output for U.S. manufacturing of the type prepared in the national income accounts is an inappropriate basis for....productivity analysis.

Moreover, Norsworthy and Malmquist [1983, p.958] show that using a value-added measure rather than a gross output multifactor measure can lead to wrong conclusions, "the incorrect choice of the value-added measurement scheme for productivity analysis of manufacturing in Japan and the United States can distort the magnitude and sometimes even the direction of productivity growth."

Constant dollar value-added is more difficult to measure than an industry's constant dollar gross output because it requires additional and more difficult data for its computation. Measuring real gross output requires data on an industry's shipments and inventory as well as an accurate measure of the price changes of these shipments and inventory (a sizeable problem in itself). Measuring real value-added requires all of the information needed to measure real gross output and, <u>in addition</u>, requires data on the inputs consumed by an industry each year, on the price and quality changes of those inputs and on the wages, profits and all other incomes generated by the industry.

Figure 1

VALUE ADDED ANNUAL GROWTH RATES, MFG AND TOTAL

SELECTED PERIODS, 1959 to 1985

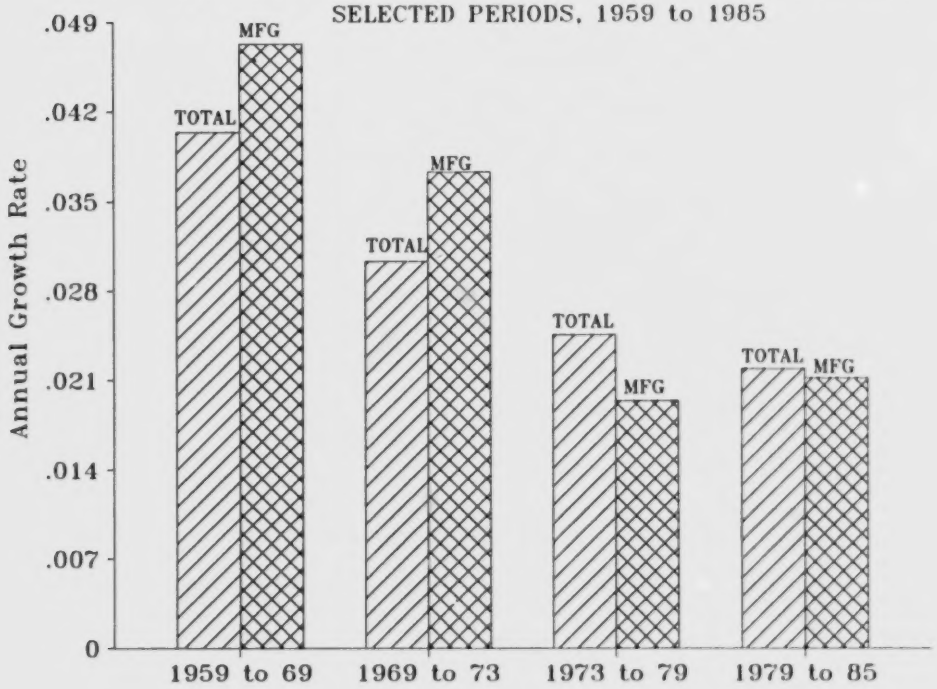
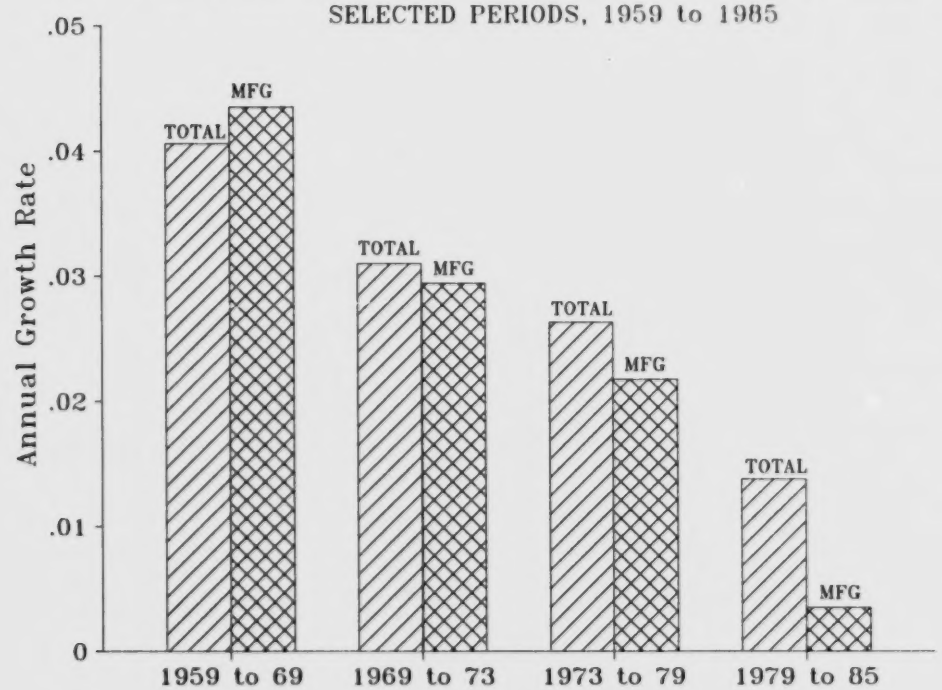


Figure 2

GROSS OUTPUT ANNUAL GROWTH RATES, MFG AND TOTAL

SELECTED PERIODS, 1959 to 1985



3. Recent Trends in Gross Output and Value-Added

Figures 1 and 2 show the growth, respectively, of constant dollar value-added and gross output in selected periods. Data are presented on both the economy-wide and the manufacturing sector's growth. In both the 1959-69 and the 1969-73 periods manufacturing value-added rose faster than total value-added in the U.S. economy; thereafter, manufacturing value-added has roughly kept even with total value-added growth. This comparison implies, of course, that manufacturing's share of total value-added has been relatively constant since 1973 (Table 1).

Table 1: Manufacturing Share of Total "Output" in Peak Years

	BEA Value-Added*	Gross Output**
1959	20.9%	35.8%
1969	22.3	36.8
1973	22.9	36.5
1979	22.2	35.6
1985	22.1	33.5

* Manufacturing Gross Product Originating/Gross Domestic Product, 1982 dollars.
** Manufacturing Gross Output/Total Gross Output, 1982 dollars.

Manufacturing gross output also rose faster than total gross output from 1959 to 1969. Since 1969, however, manufacturing gross output has lost ground, particularly after 1979 when manufacturing gross output grew only 0.3 percent annually while total gross output rose 1.4 percent annually.[9] As a result, manufacturing's share of gross output shows a sharp deterioration

of more than 2 percentage points since 1979 and a 3 percentage point drop since 1973. This erosion (relative to economy-wide growth) is equivalent to the complete elimination of the basic steel and motor vehicle industries without having any other industry rising to take their place.[10]

The post-1979 slowdown of gross output growth relative to value-added growth means there has been an increase in the ratio of value-added to gross output, hereafter referred to as "value-added intensity." Value-added intensity measures the proportion of an industry's gross output that originates in the same industry.

This increase in value-added intensity, if true, presents another puzzling contradiction. If the ratio of value-added to gross output in manufacturing rose, then the proportion of inputs purchased by the manufacturing sector had to fall. According to the value-added data, therefore, the amount of "outsourcing" by manufacturers to the domestic service sector or to foreign suppliers, or both, must have declined from 1979 to 1985.[11] Thus, if one accepts that manufacturing's share of total value-added has remained fairly constant then one must also accept the dubious proposition that there has not been a major outsourcing of manufacturing activity to the service sector and/or that there has not been a substantial increase in offshore sourcing of manufacturing components and inputs.

This puzzle is resolved below in Section 6. Before doing so, however, it is necessary to describe the methodology for measuring manufacturing value-added.

4. How Manufacturing Value-Added Is Measured

The Bureau of Economic Analysis (BEA) publishes annual estimates of value-added by industry sector in constant dollars and in current dollars. BEA refers to their measures of current and constant dollar value-added as current and constant dollar gross product originating (GPO).[12] These widely used numbers are also widely misunderstood, primarily because the concept of constant dollar value-added is hard to interpret, but also because there is very little information available on the methodology used to construct this series.

This section reviews the methodology of the GPO series. A more detailed description is presented in Appendix B, including the brief BEA description of its own methodology [Peterson, 1987].

The estimation of aggregate national output, or GNP, is a separate statistical effort from that involved in the GPO series. The goal of the GPO series is to divide GNP by sector to determine "real GNP by industry."[13]

Because of widespread misunderstandings, it is important to clearly distinguish between the constant dollar and current dollar measures of value-added in manufacturing or any other sector. Constant dollar value-added is not derived -- as is often supposed --by deflating current dollar value-added with a price index (a single deflation method). Rather, current dollar

value-added is a measure of the factor incomes generated in a sector (the wages, fringes, interest, and profits) plus non-factor charges of production (indirect business taxes and capital consumption allowances). It is developed by getting data on each source of income and charges, and distributing them to particular sectors. Thus, someone has to figure out how much of G.E.'s, and every company's, profits, depreciation and fringe benefit expenses came from its service sector activities (such as Kidder, Peabody, and NBC) and how much from its manufacturing activities. Total current dollar value-added in each sector is measured by summing all of the components of value-added attributed to that sector.

The constant dollar value-added series measures net output, as opposed to incomes. "Real" value-added increases as the quantity of goods created by producers exceeds the quantity of goods used by the producers.

BEA's ability to accurately measure a sector's real value-added depends upon the quality of the "building block" information on prices, outputs, and inputs available for that sector. It is generally assumed that the building block data are weakest when measuring service sector output and strongest when measuring manufacturing output.[14] In the manufacturing sector the building block data are sufficient to allow BEA to measure constant dollar value-added by using its preferred method, called "double-deflation." The only other sectors where the "double-deflation" method is employed are railroads, utilities, and

construction.

A Commerce Department [Grose, p.236] publication describes the double-deflation method for measuring constant dollar value-added as follows:

> The current dollar values of industry product are obtained by summing the factor costs of production (compensation of employees, net profits, net rent, and net interest) and the nonfactor charges of production (indirect business taxes, capital consumption, etc.) However, as it is not possible to factor these components into quantities and unit prices directly, the constant dollar industry measures have generally been obtained by deflating separately industry outputs and industry purchases. The difference between the two deflated figures represents the gross product of each industry in constant dollars.

This method is called double-deflation because current dollar value-added itself is not directly deflated to constant dollars i.e., converted to a quantity measure. Instead, double-deflation relies on the fact that purchases plus value-added equal gross output. One can obtain a quantity or constant dollar measure of value-added, therefore, by subtracting constant dollar inputs (obtained by deflating current dollar inputs) from constant dollar gross output (obtained from deflating current dollar gross output).

In reality, the actual measurement of manufacturing constant dollar value-added differs from the double-deflation method in several ways. One is that BEA uses an <u>indirect</u> rather than a direct measure of inputs because there are insufficient building block data and/or government resources for measuring manufacturing inputs directly. The actual measure of current

dollar manufacturing input that BEA deflates is itself an estimate derived by subtracting current dollar value-added from current dollar gross output. Therefore, the primary independent data that BEA uses in its analysis are current dollar information on gross output and value-added and price indices for inputs and gross output.[15]

The other major departure from double-deflation is that BEA "adjusts" the results after it completes the double-deflation methodology. Adjustments are necessary for recent years because all of the information is not yet available. As a result, analysts make some educated guesses. For instance, the current 1986 GPO estimates were made without benefit of the completed 1986 Annual Survey of Manufactures from the Bureau of the Census. But even where the information is fully available, BEA's computation of value-added includes an extraordinarily large number of further "adjustments" to the data <u>after it is calculated and before it is published</u>. These adjustments are more appropriately thought of as "fudge factors." There have been especially large adjustments to the data for the years between 1972 and 1974. These adjustments amount to BEA using the theoretically best methodology to get the right answer (i.e., using the double-deflation methodology with the best available data) and then, obviously dissatisfied with the answer, "correcting" it on some unspecified basis. The consequence is that BEA injects a large subjective element into its GPO estimates that critically determines its results.

5. Adjustments

This section examines the size and nature of the BEA adjustments to the GPO data and the effect these adjustments have on measured trends in GPO. The analysis focuses on the 95 percent of the manufacturing sector where double deflation methods adjustments are used -- all of manufacturing except for SIC 29, the petroleum refining industry.[16]

In order to isolate the effects of these adjustments on measured trends this paper distinguishes between the published GPO estimates, GPO^P, and the GPO estimates derived directly from the data, GPO^U, hereafter referred to as the unadjusted series.

Table 2 shows the adjustments made to the data in selected years.[17] There were large adjustments to the data for 1972 and 1973 but only modest adjustments made to the data for 1979 and 1985. The adjustments to the data for 1972 and 1973 reduced the reported manufacturing GPO by $48.7 and $54.6 billion respectively. For these years, these adjustments effectively shifted 2 percent of national output from manufacturing into other sectors.[18]

It is important to note that sizeable adjustments have been made to the data for two benchmark years, 1972 and 1977. Benchmark years are years in which a full census, rather than a partial survey, of manufacturing facilities is available. In fact, there are more data available on all sectors for benchmark

Table 2: Adjustments to Non-Oil Manufacturing Constant ($1982) Dollar GPO in Selected Years*

Year	Adjustments** (billions of 1982 dollars)	Adjustments as Share of National Output***
1972	$-48.7	-1.9%
1973	-54.6	-2.0
1977	-17.4	-0.6
1979	-3.7	-0.1
1985	1.7	0.0

* Adjustments equal published GPO less unadjusted GPO
** All manufacturing less SIC 29
*** Share of Gross Domestic Product

years than in any other years.[19] Thus, there were sizeable adjustments made to the manufacturing data even for years for which the most accurate building block data are available. Even more extraordinary is that these large adjustments were made to manufacturing data, the sector for which it is widely acknowledged we have the best data. So, a large adjustment was made to the best monitored sector in the best documented year -- 1972.

Figure 3 shows the amount of the adjustment in each year since 1972, indicating that there were only modest adjustments to the data for the years following 1977 but sizeable adjustments in the years from 1972 to 1974. This pattern of adjustment has the effect of depressing the estimate of value-added in the earlier years; therefore, the GPO series shows more growth from those years to later years. These subjective "fudge factor" adjustments thus critically distort trends calculated from the GPO data.[20]

Figure 3

LEVEL OF GPO ADJUSTMENTS BY YEAR
1972 to 1986

Table 3 shows the effect of these adjustments by comparing trends in the published and unadjusted series. The level of the adjustments dominates the official series in the 1973 to 1979 period, where published GPO rose more than three times the rate of unadjusted GPO growth, 12.2 percent versus 3.4 percent. The "fudge factor" therefore explains more than 70 percent of apparent non-oil manufacturing GPO growth between 1973 and 1979. The reason is that the $54.6 billion adjustment that lowered published manufacturing GPO in 1973 by 8.4 percent was effectively eliminated by 1979.

Table 3: Trends in Non-Oil Manufacturing Constant Dollar ($1982) GPO, 1973-85*

Time Period	GPO Published	GPO Unadjusted
1973-79	12.2%	3.4%
1979-85	14.5	13.7
1973-85	28.5	17.5

* All manufacturing less SIC 29

The effect of the adjustments on reported trends in the entire 1973-85 period are extremely large; published non-oil GPO grew 28.5 percent, while the non-oil unadjusted GPO grew only 17.4 percent, a growth rate 40 percent less. Thus, the "fudge factor" adjustments are responsible for forty percent of the 1973-85 growth of "non-oil" manufacturing constant dollar value-added.

These adjustments were not a "correction" to just a few industries. Rather, these data adjustments are widespread; in the calculation of the 1973 manufacturing constant dollar GPO there are adjustments (which lower reported output) of at least 7 percent in 12 of the 20 manufacturing industries (excluding SIC 29).

The magnitude of these adjustments is readily apparent. Lowering reported manufacturing value-added by $55 billion, as is done to the 1973 data, is equivalent to eliminating the second largest manufacturing industry -- primary metals.[21] So, even if the underlying manufacturing data had revealed such an occurrence in the 1970s the adjusted data would indicate that there had been

no loss in manufacturing GPO.

These adjustments have startling implications for the trend in manufacturing's share of total value-added (GDP) since 1973. If there had been no adjustments to the GPO data, manufacturing value-added in 1973 would have been $675.8 billion and manufacturing's implied share of total value-added in various years would be:

	1973	1979	1985
Manufacturing Share of Total Value-Added*	24.9%	22.3%	22.1%

* Unadjusted manufacturing GPO as a percentage of Gross Domestic Product

Without adjustments, manufacturing's share of total value-added in 1973 is raised 2 percentage points over that implied by the published GPO data and suffers a 2.6 percentage point drop by 1979.

6. The Value-Added Intensity Puzzle

According to the official data, as Section 3 indicated, the post-1979 increase in manufacturing value-added, along with relatively stagnant gross output, resulted in an increase in value-added intensity. This suggests a decline in outsourcing to the service sector and/or to foreign suppliers.

This increase in intensity is further confirmed by the data in Table 4 showing the growth of various measures of constant dollar manufacturing "output" from 1973 through 1985.[22] Changes in a measure of national output, gross domestic product, are shown for comparative purposes.

Table 4: Trends in Total and Manufacturing Constant Dollar ($1982) "Output", 1973-85

Time Period	Gross Domestic Product (GDP)	Manufacturing		
		Gross Output (GO)	GPO Publ. (GPO^P)	GPO Unadj. (GPO^U)
Peak to Peak				
1973 - 79	15.7%	13.3%	12.2%	3.7%
1979 - 85	13.9	2.0	13.4	12.5
1973 - 85	31.7	15.6	27.2	16.7
Downturn				
1973 - 1975	-1.7%	-9.5%	-11.9%	-15.7%
1979 - 1982	-0.7	-11.1	-9.0	-9.4
Recovery				
1975 - 1979	17.7%	25.2%	27.3%	23.0%
1982 - 1985	14.7	14.8	24.5	24.3

Rising intensity can most clearly be seen in the peak to peak movements of gross output versus published GPO shown in Table 4. These two series moved together in the 1973-79 period. Since 1979, however, published GPO has risen 13.4 percent, nearly seven times the 2.0 percent performance of gross output. The data in Table 4 also indicate that intensity increased in both the downturn and the recovery; gross output fell nearly 25 percent faster than value-added in the 1979-82 downturn and rose only 60 percent as much as value-added in the 1982-85 recovery.[23] This behavior differs from the earlier downturn where value-added fell faster in the downturn of 1973-75 and rose only slightly faster than gross output in the 1975-79 recovery.

Data on the historical significance of changes in value-added intensity to manufacturing real value-added growth is presented in Table 5 and portrayed in Figure 4. (The methodology for these computations is presented in Technical Note #1.) Table 5 should be read as follows. Published GPO rose by 27.2 percent in the peak to peak period from 1973 to 1985. Sixty percent of this GPO growth was due to the expansion of manufacturing gross output in this period while 40 percent was due to the change in the amount of constant dollar value-added generated per dollar of gross output i.e., rising value-added intensity. The data in Table 5 show that prior to 1979, almost all of the growth of manufacturing value-added in the published series was due to gross output growth. Changes in intensity were actually a drag on published value-added growth in the 1973-79 period.[24] After

Table 5: Relative Contributions of Gross Output and Intensity to Manufacturing Value-Added Growth *

Time Period	Published GPO Growth	Due to growth of: Gross Output	Intensity	Unadjusted GPO Growth	Due to growth of: Gross Output	Intensity
Peak to Peak						
1959-73**	72.0%	89%	11%	NA%	NA%	NA%
1973-79	12.2	109	-9	3.7	345	-245
1979-85	13.4	16	84	12.5	17	83
1973-85	27.2	60	40	16.7	94	6
Downturn						
1973-75	-11.9%	79%	21%	-15.7%	58%	2%
1979-82	-9.0	126	-26	-9.4	119	-19
Recovery						
1975-79	27.3%	93%	7%	23.0%	109%	-9%
1982-85	24.5	63	37	24.3	63	37

* 1982 dollars
** Based on BLS time series data on gross output and the published GPO series.

Technical Note 1

The following identity can be used to identify the relative roles of gross output and value-added intensity in recent manufacturing value-added growth:

$$(2) \quad VA_i = GO_i \cdot (VA/GO)_i, \quad i = 1...n$$

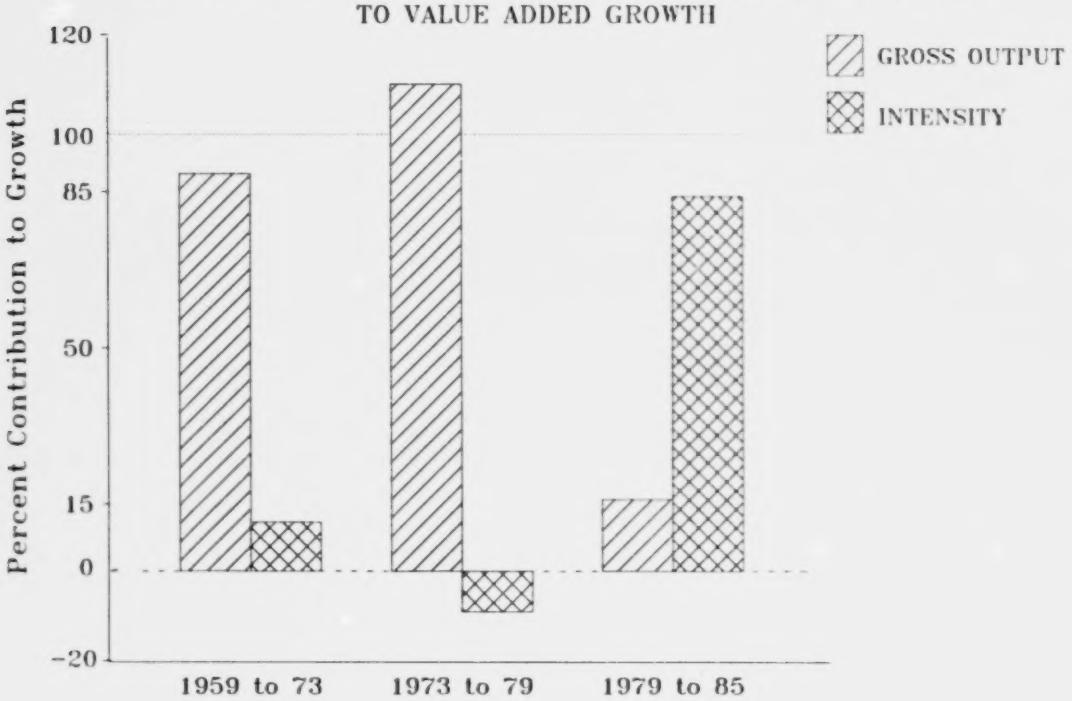
where VA and GO are constant dollar value-added and gross output and (VA/GO) represents value-added intensity in time periods i through n. The growth in value-added can be shown to be the sum of the growth of gross output and value-added intensity by taking the natural log difference of equation (2) at two points in time,

$$(3) \quad \text{Ln}(VA_2/VA_1) = \text{Ln}(GO_2/GO_1) + \text{Ln}[(VA/GO)_2/(VA/GO)_1],$$

where the term on the left hand side represents the total growth of value-added and the right hand terms represent the growth of gross output and intensity. The relative role of gross output (intensity) growth on value-added growth is the gross output (intensity) growth divided by total value-added growth.

Figure 4

CONTRIBUTION OF GROSS OUTPUT AND INTENSITY GROWTH TO VALUE ADDED GROWTH



1979, however, nearly all (84 percent) of published value-added growth reflected growing intensity. Gross output growth, on the other hand, contributed only marginally (16 percent) to value-added growth between 1979 and 1985. This shows that the rise in intensity since 1979, if it is to be believed, is overwhelmingly responsible for the growth in real value-added represented in the GPO series.[25]

If intensity has significantly increased since 1979 then it would be the first time this has happened in the post-war period. This pattern is seen in Figure 4, which shows the minor role of intensity in the 1959-73 period and the negative role of changes in intensity from 1973 to 1979. Other data suggest a similar trend was evident in the 1950s, with the rise in value-added lagging behind that of gross output.[26]

Tables 6 and 7 analyze output trends of individual manufacturing industries in order to determine whether the rise in value-added intensity is widespread or simply the result of changing conditions in a few industries. Table 6 examines gross output growth in the two last peak to peak periods. Each industry is categorized as either expanding or contracting. These data indicate a widespread deceleration of gross output growth in the 1979 to 1985 period compared to the prior six years. This overall shift downward is evident in the fact that nine industries (accounting for nearly 42 percent of manufacturing gross output in 1979) actually contracted in the 1979-1985 period. In contrast, only four industries (accounting for just 10 percent of 1979 manufacturing gross output) actually contracted in the 1973-1979 period. On the other end, there was no corresponding broadening of the share of manufacturing which grew faster than average (line 4).

Table 7 presents information on the changes in value-added intensity within the 21 manufacturing industries in the same two peak-to-peak periods. Although the same number of manufacturing industries experienced rising value-added intensity in each period (15 of the 21) their importance has grown; industries with rising value-added intensity in the 1979-85 period comprise 82 percent of all manufacturing gross output, up from the 57 percent share of gross output of "rising intensity" industries in the 1973 to 1979 period. These data show that according to the GPO data recent increases in value-added intensity have been

Table 6: Gross Output Growth in Manufacturing Industries, 1973-85

Gross Output Growth*	1979 - 1985 Number of Industries**	1979 - 1985 Percent of Gross Output***	1973 - 1979 Number of Industries**	1973 - 1979 Percent of Gross Output***
(1) Declining	9	41.5%	4	9.8%
(2) Rising at less than half the avg. growth.	2	10.3	7	25.5
(3) Rising less than avg. but more than half the average.	3	10.5	5	26.4
(4) Faster than avg. growth.	7	37.8	5	38.3
(5) Total	21	100%	21	100%

* Average growth is measured by changes in total real gross output.
** 21 industry breakdown with Motor Vehicles broken out as BEA does.
*** Share of manufacturing gross output in 1979.

Table 7: Changes in Value-added Intensity Across Manufacturing Industries, 1973-1985 *

	1973 - 1979 Number of Industries	1973 - 1979 Share of Gross Output**	1979 - 1985 Number of Industries	1979 - 1985 Share of Gross Output**
1. Increasing Intensity***				
a. Contracting	3	2.6%	8	40.7%
b. Expanding	12	54.7	7	41.1
Subtotal	15	57.3	15	81.8
2. Decreasing Intensity***				
a. Contracting	1	7.2	1	0.8
b. Expanding	5	35.5	5	17.4
Subtotal	6	42.7	6	18.2
Total	21	100%	21	100%

* Intensity measured with published GPO value-added data.
** Share of manufacturing gross output in 1979.
*** Industries divided into two groups, those with increased (expanding) and those with decreased (contracting) levels of constant dollar gross output.

widespread throughout manufacturing. Rising intensity is not due to developments in just a few industries.

The widespread rise in value-added intensity implies that the phenomenon is not due to a shift toward more value-added intensive manufacturing industries -- a change in the "mix" of industries. This point raises the question of whether the changing structure of manufacturing caused a rise in overall intensity due to high-intensity industries expanding and low-intensity industries contracting? This question can be answered using a "shift-share" analysis. Using two-digit measures of value-added intensity in 1979, one can show what the average manufacturing intensity would have been in 1979 if the 1985 relative size of manufacturing industries (in terms of constant dollar gross output) had prevailed. This "shift-share" analysis shows that the changing mix of industries since 1979 did raise intensity by 2.3 percent. But, this accounts for only one-fifth of the 11.2 percent intensity increase in the 1979-85 period (from 31.52 percent to 35.04 percent). The changing mix of industries, therefore, is not an adequate explanation of rising intensity.[27]

Again, a large increase in value-added intensity implies that there has been a proportional decline in inputs obtained from other sectors and from overseas. Rising intensity appears, therefore, to contradict evidence that there has been a substantial increase in outsourcing manufacturing work to the services sector and/or to offshore suppliers.

Actually, many claims of increased outsourcing to the service sector seem to have been overstated. A number of economists have suggested that there has been a substantial increase of outsourcing to the service sector.[28] The significance of this increased outsourcing is usually said to be that government data overstate the decline in manufacturing employment because some manufacturing work is now performed by service sector firms. The issue here is whether there has been a shift of value-added from manufacturing to the service sector sufficient to force value-added intensity to decline.

In any event, BLS two-digit multifactor productivity data suggest that the effect of any outsourcing of previous manufacturing activity to the service sector may be small. Current dollar service sector inputs to the manufacturing sector (e.g. computer services, building maintenance, legal and accounting services) accounted for only 9 percent of gross output in 1972 and have only slightly increased in importance since then.[29] Therefore, even a much faster percentage growth of service inputs which were previously "in house" activities will not greatly affect manufacturing value-added estimates.[30]

A more rigorous calculation using constant dollar data confirms the small potential effect of outsourcing to the service sector on manufacturing value-added. (The method for estimating constant dollar value-added changes from the BLS data is presented in Technical Note #2.) The data do show that service sector inputs have risen some 50 percent faster than

materials inputs. But even if all of the extra increase in service inputs were due to a shifting of activities to the service sector, manufacturing constant dollar value-added growth for the 1973-79 period would have been only 0.8 percentage points higher, rising from 3.8 percent to 4.6 percent.[31] The 1979 to 1983 growth rate (1983 is the latest year in this series) is raised from 2.3 to 4.0 percent.[32] This increase is hardly enough to substantially affect value-added intensity or manufacturing's share of total value-added. So, it is likely that whatever service sector outsourcing has taken place has not substantially affected value-added intensity.

The other major reason for expecting falling value-added intensity is the evidence on increased offshore outsourcing of components and parts. The rapid increase in all manufacturing imports (inputs and final products) relative to domestic manufacturing gross output from 1979 to 1985 leaves little room for doubt that a significant increase in offshore sourcing has occurred. Manufacturing imports, in current dollars, more than doubled from 1979 to 1985 while current dollar gross output rose by just 31 percent. Because prices of domestic products rose much more quickly than import prices in this period, the differences in the measures of the <u>quantities</u> of imported versus domestic manufactured goods is even larger; the quantity of imported manufactured goods rose 93 percent from 1979 to 1985, some 46 times faster than the meager 2 percent growth of real domestic gross output. Even if the amount of imported

Technical Note 2: Multifactor Productivity Data Derivations of Purchased Input and Value-Added Indices

To measure annual changes in the quantity of purchased inputs:

$$(1)\quad LnI_t - LnI_{t-1} = \sum W^i \, (LnI^i_t - LnI^i_{t-1})$$

Where quantity growth of three inputs (Energy, Materials, Services) based on MFP indices are aggregated using each input's share of current dollar total inputs (e.g., the share of energy purchases relative to all purchased inputs), W, averaged over years t and t-1. The annual change values are then used to develop an index with 1949 set at 100.

A comparable method is used to measure annual changes in the prices of purchased inputs:

$$(2)\quad LnP_t - LnP_{t-1} = \sum W^i \, (LnP^i_t - LnP^i_{t-1})$$

Where changes in MFP input price indices are weighted by a particular input's share of current dollar input purchases in years t and t-1. The annual changes are then used to develop an index with 1949 set at 100.

The purchased input and gross output quantity indices can be used in the following equation to solve for annual changes in constant dollar value added.

$$(3)\quad LnS_t - LnS_{t-1} = W^V \, (LnVA_t - LnVA_{t-1}) + W^I \, (LnI_t - LnI_{t-1})$$

Where S, VA, and I represent index values of the quantity of gross output, value added, and purchased inputs, and W^V and W^I are the current dollar shares of value added and purchased inputs in gross output for years t and t-1. Solving (3) for ($LnVA_t$ - $LnVA_{t-1}$) yields annual changes in constant dollar value added which are used to develop an index with 1949 set at 100.

manufacturing components increased half as much as other manufactured imports (e.g., final consumer products) these figures suggest large increases in the share of imported inputs incorporated into domestically produced manufactured goods and therefore a reduction in value-added intensity.[33]

Federal Reserve Board (FRB) data provide another indication of the increased use of imported materials. The 1979-85 period is the first time that the FRB measures of production trends for materials and for products have diverged. From 1979 to 1985 the production of products grew 18 percent while materials production rose just 3.5 percent.[34] The Federal Reserve Board's [1986, p.12] primary explanation for this development is:

> Domestic producers of raw materials have faced stiff competition from foreign producers. Moreover, domestic industries import many parts for their products, such as semiconductors, auto engines, and specialty steel; these parts are classified as materials.

So, increased imports provide a strong reason for expecting gross output to grow faster than value-added thereby leading value-added intensity to <u>fall</u>. Yet, intensity has risen sharply according to the GPO data, a rise that can only partially be accounted for by the changing mix of industries within manufacturing.

A possible explanation for rising intensity could be a better utilization of energy inputs in response to recent energy crises. The problem with this explanation is that energy inputs

comprise a small share of current dollar gross output, just 3.5 percent in 1979.[35] Plus, energy conservation would not explain falling intensity after the first energy price shock in 1973 but rapidly rising intensity after the second energy price shock in 1979.

Given these contradictions, it is a reasonable proposition that the explanation of increased intensity is to be found not in the real world but in the mismeasurement of manufacturing value-added trends in the GPO series. In particular, there are two measurement problems that might explain why the series shows this dubious rise in intensity after 1979. Both measurement problems are due to the inability of our statistical establishment to keep pace with shifts in the nature of our economy, imports on the one hand, and shifts in the corporate structure on the other. (Appendix C provides a detailed examination of these measurement problems.)

The major measurement problem is that the price indices used to measure changes in input prices (based on the BLS Producer Price Index, (PPI), series) are solely based on prices of goods produced domestically.[36] Yet, manufacturing inputs are also obtained from abroad and increasingly so. If, as is reasonable to assume, imports are cheaper and/or of better quality than domestic goods then a price index of domestic prices during a period of increasing import penetration will systematically overstate input price increases and understate input quantity increases. More important, this creates a systematic bias toward

overstating constant dollar value-added growth. This tendency is especially true during a period of a rising dollar when import prices rise much more slowly than domestic prices (manufacturing import prices rose 8 percent from 1979 to 1985 while domestic manufacturing prices rose 29 percent).[37] Changes in the construction of the PPI series make matters even worse. The PPI series formerly incorporated some import prices but phased them out during the revision of the series between 1978 and 1986. This change in the methodology exacerbates the problem for the GPO series.[38]

Difficulties in measuring the growth of current dollar inputs represent a second reason to suspect mismeasurement. As discussed earlier in Section 4, current dollar inputs are measured indirectly in the GPO series. Inaccuracies will develop if the GPO series overstates the amount of factor incomes (wages, profits, interest and so on) generated by the manufacturing sector. The problem arises because some data (profits, interests, fringe benefits, and depreciation) are only available on an enterprise (or company) basis. As a result, BEA must allocate these various costs of each enterprise to all of the industries in which the enterprise operates. For instance, BEA must determine what proportion of G.E.'s profits, depreciation and fringe benefits is due to its broadcasting, brokerage, manufacturing, banking and other activities. Most BEA information for doing so, however, dates back to 1972. Given the substantial increase in diversification, corporate debt, mergers,

acquisitions, and growth in fringe benefits since that time it is likely that BEA is overstating manufacturing incomes and therefore understating the growth of manufacturing inputs.[39]

7. Comparing GPO Trends to Those of Other Data Series

Fully judging the reliability of the GPO series requires that we compare trends in the GPO series to comparable trends from other, independent data series. This section summarizes the results of comparisons of the GPO value-added series to comparable series issued by the government. (More detailed comparisons are presented in Appendix D.)

Value-added data from BEA Input-Output (I-O) tables can be used as a point of comparison to the GPO series.[40] Data from the BEA I-O tables are the most comprehensive, complete, and reliable information available on particular industrial sectors. These data are primarily based on the detailed industry statistics provided in the economic censuses conducted every five years, the last ones available being for 1972 and 1977. BEA has also issued an interim, updated I-O table for 1981. The advantage of the I-O tables are their completeness and accuracy since they incorporate all of the available information for a particular year.[41] The disadvantage of the I-O data for comparison purposes is that only current dollar information on gross output, value-added, and inputs are available and that the data are somewhat out of date. However, constant dollar data can be constructed from the I-O data using GPO price indices. (See Appendix D.)

A comparison between the I-O and the GPO value-added series shows that the GPO series seriously overstates manufacturing

output growth. Table 8 presents a comparison of the estimated I-O and the GPO constant dollar value-added trends between 1972 and 1981. Again, the comparison concentrates on the non-oil manufacturing sector -- the sector accounting for 95 percent of manufacturing value-added -- for which BEA employs the double-deflation method.

Table 8: Comparison of I-O and GPO Constant Dollar Value-Added Trends*

	1972-77	1977-81	1972-81
(1) Input-Output**	13.1%	-1.4%	11.6%
(2) GPO-Published	14.8	5.6	21.6
(3) Difference (1 - 2)	-1.7	-7.0	-9.6

* Trends for manufacturing sector less SIC 29
** Constant dollar value-added computed at two-digit level using GPO prices indices and I-O current dollar gross output and input data.

This comparison with the I-O data shows that the GPO series vastly overstates manufacturing constant dollar value-added growth. The differences between the two series are modest for the time period where the GPO series is adjusted -- between 1972 and 1977. After 1977, however, the GPO data and I-O data seriously diverge to the point where they do not even move in the same direction. For the 1977-81 period the GPO data show a rise in constant dollar value-added of 5.6 percent, while the I-O data show a fall of 1.4 percent. For the entire 1972-81 period the GPO series shows manufacturing "output" growing 83 percent, or 9.6 percentage points, faster than the I-O series.

The primary reason for these differences is that the I-O data show a faster rate of growth in manufacturing current dollar inputs, a finding which supports concerns expressed in Section 6 concerning the possible GPO mismeasurement of current dollar inputs. These differences are exacerbated by the adjustments made to the GPO data.

Thus, the GPO series provides a far different and a far more optimistic picture of manufacturing trends than the I-O data provide. The divergence of the I-O and GPO series since the last benchmark in 1977 suggests that the GPO series has gone astray and will require a large correction when the I-O benchmark table for 1982 becomes available in 1989.

Another important conclusion from the comparison of the I-O and GPO data trends is that real value-added trends are very sensitive to seemingly small differences in the measurement of current dollar input growth or input price inflation. Because inputs comprise the largest share of gross output (64 percent), any change in input measurement has a roughly double effect on the measurement of value-added. For example, current dollar inputs grew 9.7 percent faster from 1977 to 1981 in the I-O than in the GPO series. This difference caused current dollar value-added in the GPO series to increase 23 percent faster than in the I-O data.

The Federal Reserve Board Industrial Production Index (IPI) series measures "as much as possible, changes in the physical quantities of output (tons of steel, barrels of crude oil,

assemblies of autos)." The concept of production in the IPI series is thus comparable to that of gross output. However, the IPI is a mixture of both gross output and value-added because the aggregate manufacturing index is obtained by using value-added base weights to combine production indices of particular industries. The IPI trends are frequently compared to those in the GPO series, despite the fact that the IPI data do not provide a measure of constant dollar value-added.[42]

Table 9: Comparison of Federal Reserve Board Industrial Production Index (IPI) With GPO Trends for Selected Industries, 1979-85

Industry	Percent Change, 1979-85	
	Value-Added (GPO^P)	Production (IPI)
Food	14.6%	22.0%
Tobacco	-26.1	-4.1
Lumber	-2.5	11.2
Printing and Publishing	13.3	36.6
Chemicals	1.9	14.1
Stone, Clay, and Glass	-5.0	4.0
Machinery, Exc. Elec.	64.1	18.5
Automobiles	-0.5	16.3
Other Transport	21.8	7.8

Source: Appendix Table D-5

The IPI series grew 50 percent faster than the GPO measure of constant dollar value-added in the 1973 to 1979 period, an 18.6 versus a 12.2 percent growth. Trends in the IPI manufacturing series exactly match those in the GPO series for 1979 to 1985 period, with each series showing 13.4 percent growth. The apparent agreement between the GPO and the IPI

series in the 1979 to 1985 period, however, is purely accidental. Table 9 provides some examples of the stark differences in growth portrayed by the IPI and the GPO series at the industry level. A comparison of all GPO and IPI trends at an industry (two-digit) level shows that the industry growth rates in the series are rarely within 25 percent, plus or minus, of each other. For example, if the GPO series showed 20 percent growth for an industry it would be unusual for the IPI series to show industry growth anywhere in the range of 15 to 25 percent. The overall IPI and GPO agreement, therefore, results from a canceling out of disagreements at the industry level so that neither series actually reflects well on the other.

8. The Problem of "Base Years" for Historical Constant Dollar Comparisons

Another problem of the BEA constant dollar value-added data lies in the selection of the base year. The GPO series is now presented in constant "1982 dollars." The issue this section addresses is whether this is appropriate for long-term historical analyses which compare the relative sizes of different sectors. For instance, does it matter if the analysis is done in "1972 dollars" or "1982 dollars" when assessing post-war structural change? The answer is that it does matter, and drastically so. Because prices of manufactured goods have risen more slowly than other goods, an historical "constant dollar" comparison using a recent "base period" such as 1982 systematically understates manufacturing output in earlier years, therefore masking an historical relative decline in manufacturing's share of total output in the post-war period.

Research by economist Nicholas Perna [1987, p.32] demonstrates this measurement problem, which he refers to as a "fundamental index problem: the size of manufacturing's share is very sensitive to the particular base period used in calculating real GNP. The more recent the base year, the smaller the manufacturing share of real GNP." Perna makes this point using the data presented in Table 10, data showing manufacturing's share of output in 1948, 1969, and 1984 when measured in 1958, 1972, and 1982 "constant dollars." For 1948, for instance,

manufacturing's share drops from 29.7 percent to 21.5 percent by just shifting the base year from 1958 to 1982. Similarly, manufacturing's share in 1969 can be reduced from 31.0 percent to 22.1 percent by shifting from a 1958 to a 1982 base year.

Table 10: Manufacturing Share of Real GNP

Base Year	1948	1969	1984
1958	29.7%	31.0%	
1972	24.8	25.4	23.9%
1982	21.5	22.1	21.8

Source: Perna [1987,p.32]

The point is, what was manufacturing's share in 1969 and with what base year (weighting scheme) should it be measured? As Perna states, "the further one gets from the base period, the less representative it is of the economy's actual structure." Therefore, the weighting scheme or base year applied to a particular year should be from a relatively close time period. However, the GPO series uses the recent base period, (currently 1982) and applies it to the entire 1947-85 time period.

Perna contrasts this to the way BLS handles the Consumer Price Index (CPI), an index which measures the price changes for a fixed market basket of goods (the percentage of consumption represented by various goods and services being held constant). The actual market basket is periodically revised, thus changing the "weights" applied to the price data. Yet the entire historic

data is not recast (i.e., recalculated) to reflect new buying patterns (weights) since "the 1980's proportion of consumer spending is no more relevant for the 1950's than the 1950's basket is for the 1980's." The GPO series, however, applies 1982 relative prices (the "weights" of the GPO series) to the entire post-war period. The consequence is a systematic understatement of the importance of manufacturing in earlier periods.

Table 11: Manufacturing's Relative Productivity Level in 1982 and in 1972 Constant Dollars

Year	Manufacturing Value-Added Per Hour		GNP* Per Hour		Manuf. Relative Productivity**	
	($1972)	($1982)	($1972)	($1982)	($1972)	($1982)
1967	$6616	$12,919	$7423	$16,674	89%	78%
1972	7913	15,182	8248	18,142	96	84
1977	9001	17,116	8825	19,063	102	90
1982	9572	18,046	9110	19,416	105	108

* Gross National Product
** Manufacturing value-added per hour divided by Gross National Product per hour i.e. columns (1)/(3) and (2)/(4).

These same points are illustrated in a different manner in Table 11, which presents data on the relative productivity of manufacturing workers using the GPO series in 1972 dollars and in 1982 dollars.[43] These data address whether labor productivity in manufacturing is higher or lower than that in the rest of the economy. The result is that the answer depends on which base period or "constant dollar" series is used. Using the 1972 constant dollar series manufacturing productivity was 96 percent of the average in 1972 and was above average by 1977. With a more recent base period such as 1982, a far different answer

emerges; manufacturing productivity was only 84 percent of the average in 1972 and only rose to above average by 1982 (rather than by 1977). The basic structure of the economy, therefore, appears to be different depending upon the base year chosen for the analysis.

9. Alternative Estimates of Manufacturing Output Trends

This section examines manufacturing output trends under various alternative assumptions regarding output growth. The purpose of this exercise is to provide a range of answers to two questions: (1) how much has manufacturing's share of national output changed in recent years?; and (2) how much of the relative shrinkage of manufacturing employment is due to relatively faster productivity growth and how much is due to relatively slower output growth?

Table 12 presents five alternate methods of estimating manufacturing constant dollar value-added growth for the 1972-85 period:

(1) the GPO -- published data series;

(2) the GPO -- unadjusted series;

(3) an estimate assuming that constant dollar value-added growth parallels that of constant dollar gross output growth;

(4) an estimate using constant dollar value-added estimates from input-output data (see Table D-3) for the 1972-81 period and assuming constant dollar value-added growth parallels constant dollar gross output growth from 1981 to 1985;

(5) an estimate using constant dollar value-added growth based on the unadjusted GPO series for the 1972-79 period and assuming growth equal to constant dollar gross output

growth from 1979-85.

The first two estimates are simply the published and the unadjusted GPO series. The third estimate makes the conservative assumption that value-added grew as fast as gross output. After all, gross output has generally grown faster than value-added in the post-war period. This estimate allows for no increase or decrease in the value-added intensity. A similar assumption was used in a recent Commerce Department study.[44] The fourth estimate lets the Input-Output data govern growth for the period for which they are available and then assumes no intensity increase since 1981.[45] The last estimate uses the unadjusted series for the 1972-79 period, thereby negating the effect of the adjustments. Beyond 1979 the estimate assumes no change in value-added intensity.

The data in Table 12 show that the published GPO series grew by 40.8 percent from 1972 to 1985, somewhat faster than the economy-wide (GDP) growth of 38.2 percent in this period. This finding implies that manufacturing's share of total output has remained relatively constant. The unadjusted series shows much less growth than the published series in the 1973-79 period and 11.0 percentage points less overall growth in the 1972-85 period (see Table 12, column 3).

The gross output based estimate (Estimate 3) shows growth equal to that of the GPO-published series in the 1970s but substantially lower growth in the 1980s. The result is that

Table 12: Various Estimates of Manufacturing Value-Added Growth, 1972-85

Estimate	Basis	Value-Added Growth ($1982)	Change in Manufacturing Share of Output*		Proportion of Employment Share Lost Due to:	
					Productivity	Output
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		1972-85	1972-85	1973-85	(1972-85)	
One	GPO-published series, 1972-85	40.8%	+0.4% pt	-0.8%pt	107%	-7%
Two	GPO-unadjusted series, 1972-85	29.8	-1.5	-2.8	76	24
Three	Set value-added growth equal to gross output growth, 1972-85	23.8	-2.3	-3.4	60	40
Four	Estimated I-O value-added growth, 1972-81, and gross output growth, 1981-1985	20.7	-2.7	-3.9	50	50
Five	GPO-unadjusted growth, 1972-79 & gross output growth, 1979-85	17.2	-3.3	-4.5	40	60

* Share of Gross Domestic Product

overall growth for the 1972-85 period shown by Estimate 3 is only 23.8 percent, far less than the 40.8 percent growth in the GPO-published series. Estimate 4 shows even lower growth relative to the GPO-published series, primarily because of the much slower growth of constant dollar value-added in the 1977-81 period (based on input-output estimates). Estimate 4 shows only half the growth of constant dollar value-added that the GPO-published series shows for the entire 1972-85 period. Estimate 5 shows the least growth in constant dollar value-added, rising only 17.2 percent over the 1972-85 period. This growth is only 42 percent of the 40.8 percent growth shown in the GPO-published series for the same time period.

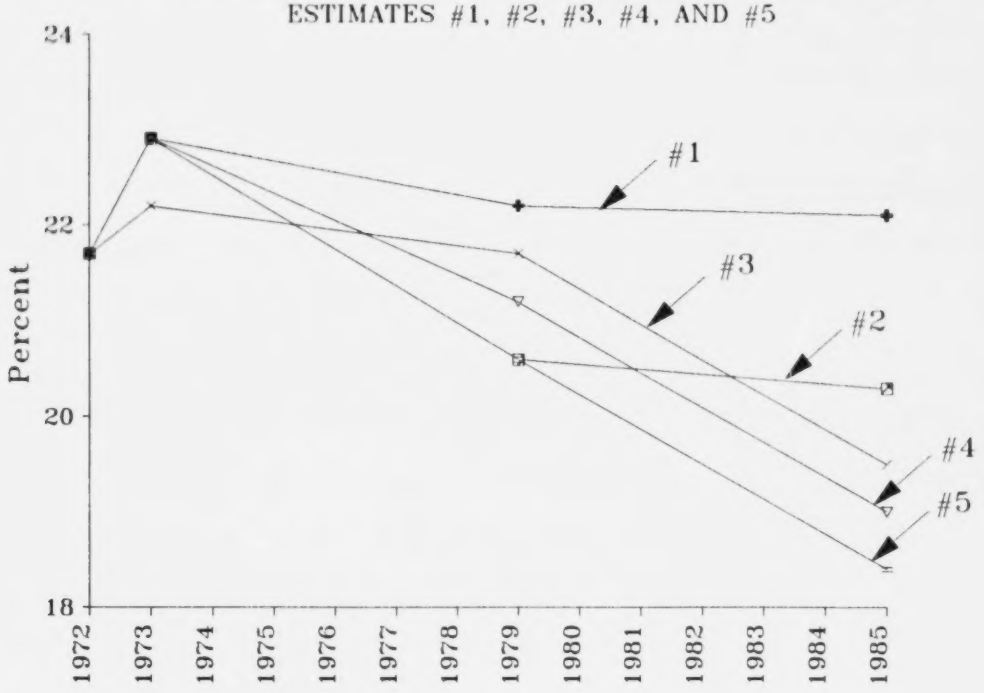
This analysis shows that reasonable assumptions about manufacturing constant dollar value-added growth can yield far different output trends than those shown by the published-GPO series. Table 12 addresses (in columns (4) and (5)), and Figure 5 shows, the effect these varying estimates of manufacturing value-added growth have on the measured share of manufacturing value-added output in total value-added (GDP).[46] The published-GPO series shows an 0.4 percentage point rise in manufacturing's share from 1972-85 while other estimates show a loss of output share of from 1.5 to 3.3 percentage points by 1985.

Manufacturing's share of output peaked in the published GPO series in 1973 at 22.9 percent and fell 0.8 percentage points by 1985. The alternative estimates of manufacturing growth imply sizeable losses in manufacturing's share of total output.

Figure 5

CHANGES IN MFG SHARE OF OUTPUT, 1972-1985

ESTIMATES #1, #2, #3, #4, AND #5



Relative to the 1973 peak, Estimates 2 through 5 imply a loss of output share of from 2.8 to 4.5 percentage points, losses ranging from 13 to 20 percent of the 22.2 percent contribution of manufacturing to total output in 1979. Figure 5 portrays the changes in manufacturing's share of output since 1972. All but the official published GPO series (Estimate 1) show a significant decline in manufacturing's share of output.

Table 12 also shows the differing impact of these various output estimates on the degree to which the 5 percentage point drop (from 23.3 to 18.3) in manufacturing's share of total employment from 1972 to 1985 is due to manufacturing having relatively faster productivity growth or is due to its having

relatively less output growth. Columns (6) and (7) show the proportions of the loss in employment share accounted for by faster productivity and by slower output growth.[47]

The common assertion that manufacturing employment's relative decline is solely due to manufacturing's relatively faster productivity growth is supported only by the GPO-published series (Estimate 1). Using the unadjusted GPO series (Estimate 2) reduces the role of productivity growth to explaining only 76 percent of the employment shrinkage. Estimates 3 and 4 suggest that from 50 to 60 percent of the employment shrinkage in the 1972 to 1985 period can be explained by productivity improvements. Estimate 5, which shows the slowest growth in manufacturing output, implies only 40 percent of the employment shrinkage is due to productivity growth. These calculations show how sensitive the "explanations" of manufacturing's employment contraction are to the varying estimates of manufacturing's output growth.

Productivity explains even less of the shrinkage of manufacturing employment in the most recent period, 1979 to 1985. Three different measures are available to assess the role of productivity growth in the contraction of manufacturing employment in this period. First, the published GPO series (Estimate 1) suggests that nearly all of the 1979-85 employment shrinkage is productivity related. Second, gross output based estimates (as in Estimate 3 and 5 and in Estimate 4 for the 1981-85 period) indicate that only one-third of the 3.7 percentage

point shrinkage of manufacturing's employment share is based on manufacturing's relatively fast productivity growth. Third, we have calculated an additional measure which allows manufacturing output to increase as much as gross output plus an amount due to the increase in value-added intensity related to the shift towards higher intensity industries.[48] According to this conservative methodology (conservative, because value-added has traditionally grown slower than gross output) productivity growth explains only 48 percent of manufacturing's employment shrinkage in the 1979-85 period. Thus, despite productivity improvement, had there not been a relative slowdown in manufacturing output growth in this period there would have been nearly two million more manufacturing jobs in 1985.[49]

Conclusions

If the GPO data are to be treated skeptically then what information can be relied upon to assess manufacturing output trends? As is usually the case with risky situations, the best approach is to diversify. Thus, we should rely on a variety of measures. One important measure to track is constant dollar gross output. There are relatively fewer measurement problems with gross output than with value-added. (The major measurement problem with gross output is that increased or decreased firm (vertical) integration can bias the data, a factor that would provide an upward bias to gross output growth in the recent period.) For a variety of reasons there should be more attention paid to gross output trends: there is general consensus among data sets on its measurement; it is important to productivity analysis: and it is easy to interpret. Unfortunately, there is no readily available and timely published series on constant dollar gross output. A second best series is the constant dollar final sales of manufacturers series that BEA releases quarterly. A measure of gross output can be computed by combining the data on inventory changes with the sales data.

The most accurately measured sectoral data are those for wages and salaries and for employment. These data all show a shrinkage in manufacturing relative to the rest of the economy. Part of this shrinkage is due to the higher productivity growth

of manufacturing and the low productivity of the service sector. However, the estimates of manufacturing constant dollar value-added presented in Section 9 imply a wide range of "output" growth rates for the 1972-85 period (from 1.1 to 2.3 percent per year). These estimates imply an equally wide range of estimates for labor productivity growth. Manufacturing's relative employment and wage shrinkage should not be readily discounted, unless one has great faith in the output measure used to calculate productivity trends. Therefore, with a wide range of possible labor productivity growth rates the permanent job losses and plant shutdowns experienced by manufacturing in the 1980s do signify, in part, an eroding industrial base.

Uncertainty about manufacturing output trends also clouds important comparisons of current U.S. manufacturing productivity growth relative to that in other time periods, other countries, and other sectors. First, consider comparisons over time. The manufacturing output estimates presented above suggest that there was less growth in each of the two periods, 1973-79 and 1979-85. The productivity comparison between these two periods, however, is primarily dictated by the fact that hours grew 0.5 percent annually from 1973 to 1979 but fell 1.3 percent annually from 1979 to 1985. As a result, the various estimates of manufacturing output growth still imply a substantial improvement (a doubling) of manufacturing productivity growth in the recent period. The only exception is a gross output per hour productivity measure which shows a 1.6 percent annual rise in

each period.

If our productivity has not improved as much as the GPO series suggests, then the competitive position of the U.S. is probably worse than has been assumed. For example, Kendrick [1987], using GPO based data, calculates that U.S. manufacturing productivity in the 1979 to 1985 period rose at the same 3.5 percent rate as eleven other industrialized countries. This performance seems to compare favorably to the 1973-79 period where U.S. manufacturing productivity growth was 40 percent of that of other countries.

But adjusting for overstatement of U.S. manufacturing output in each of these periods suggests that our current performance still lags behind that of other countries. Using a gross output per hour productivity measure (corrected for industry mix) suggests that U.S. manufacturing productivity advanced at 60 percent of that of other countries between 1979 and 1985. So, we are doing better but not well enough.

Finally, if manufacturing output and productivity growth have indeed been overstated then our estimates of nonmanufacturing productivity growth have been understated as well. A manufacturing productivity growth rate of 1.9 percent (based on gross output per hour adjusted for industry mix) implies a nonmanufacturing rate of 0.7 percent, a much higher rate than the 0.1 percent implied in the official data show.[50] Nevertheless, manufacturing productivity still appears to be nearly three times that of the remainder of the economy.

It is unexciting but necessary to proclaim the need for better quality data for manufacturing, including faster development of input-output tables, more detailed historical data on import prices, and more current linkages for allocating firm based data to particular industries. The much needed improvement of service sector data would also provide better methods of attributing real GNP by sector. There are too many critical questions regarding productivity, competitiveness and structural change that rely on data which at present are unreliable. We need to devote more resources to build a more effective statistical establishment for collecting and analyzing sectoral data. Plus, the statistical establishment needs to monitor its own output in a better manner through peer review and self-critical internal assessment.

Developing a satisfactory statistical series for manufacturing output and productivity is unfortunately not on the horizon. What we can say for the present is that the available evidence suggests that manufacturing's share of the economy has declined and that the GPO series cannot, without substantial caveats, be used to make a case against the deindustrialization thesis.

ENDNOTES

The following abbreviations are used in the footnotes. NIPA refers to the National Income and Product Accounts as found in the historical tables [Commerce, 1986b] and the revisions through July 1987. ERP refers to the tables in the Economic Report of the President, 1987. SCB is an abbreviation for the Department of Commerce publication Survey of Current Business.

1. Data for the compound annual growth rates are: job loss -- unpublished BLS tabulations from the January 1986 Displaced Worker Survey, Table 2A; constant dollar shipments -- unpublished BEA data for 1973, SCB (February 1986), p.46 for 1979 and SCB (September 1987), p.64 for 1985; constant dollar net stock of manufacturing fixed capital -- SCB (January 1986), Table 4, pp.58-59 and SCB (August 1987), Table 4, p.10. The time period from 1973 to 1985 is chosen to match the period for which the GPO series is analyzed below.

2. Goods demand measured as gross domestic purchases of goods. Goods production measured by the increase in final sales of goods and changes in goods inventories, NIPA Table 1.4.

3. Data are for merchandise exports and merchandise imports less petroleum imports in 1982 constant dollars from NIPA Table 4.4.

4. This paper shows that this analysis is wrong because the data on which it is based are erroneous. This analysis is also wrong because it focuses on a manufacturing aggregate. A disaggregated analysis shows that declining shares of output are responsible for employment shrinkage in a majority of manufacturing industries. Industries comprising half of manufacturing in 1979 had lost ten percent or more of their share of gross domestic product by 1986; industries representing two-thirds of manufacturing output lost output share. While the decline was widespread the expanding sector is narrow, primarily comprised of two industries representing one-fifth of manufacturing output (SIC 35 and 36). In fact, without the growth of SIC 35 (which includes the computer industry), the official GPO data show a decline in manufacturing's share of output of 2.4 percentage points (from 20.4 to 18.0) from 1973 to 1986.

5. ERP [1988, p.62 and 64]. See ERP [1988, p.97] for statement that manufacturing's constant share of output shows that manufacturing has not suffered trade related problems.

6. The U.S. suffered a net export decline from 1979 to 1985 (equivalent to 3.6 percent of national output) that caused large losses of manufacturing jobs and output. That changes in net exports since 1979 have caused the loss of millions of manufacturing jobs and significant lost output is shown in Lund [1986], Stone and Sawhill [1987], and Young et al [1986].

I wish to acknowledge Lee Price's contribution in suggesting the comparison to Japan. The data for Japan are from the Government of Japan Economic Planning Agency [1987]. The data for the U.S. are the nonpetroleum merchandise net exports as a share of GNP in constant 1982 dollars.

7. See Mohr and Christy [1986] for a further comparison of gross output and value-added.

8. These economic assumptions concern the combining of different inputs (energy, materials, and services) into an aggregate input measure and concern the combining of labor and capital into a value-added measure. Economists talk about these assumptions in terms of "separability." The essence of the concern about separability is that in aggregating inputs it is assumed that the substitution between them (labor and capital) is independent of the level of other inputs (e.g. energy).

9. Gross output trends are calculated from BLS Time Series Data on Gross Output. See Kutscher and Personick [1986] for a description and other use of these data. The BLS series has the longest time series on gross output. The value-added trends are calculated from the GPO series, NIPA, Table 6.2.

10. This is calculated using BLS gross output data for blast furnaces and basic steel products, and motor vehicles and car bodies.

11. Another possibility is a fall in the purchase of inputs by manufacturing industries from other manufacturing industries.

12. The terms value added and gross product originating are used interchangeably in this paper.

13. These data are used to track structural changes in the economy (for instance, trends in shares of output arising from farming or manufacturing) or in productivity analysis (for instance, by combining GPO data with other data on employment or hours). These data are presented in NIPA Tables 6.1 and 6.2 and in ERP Table B-10 and B-11. See Grose [1970] for a brief review of the uses of GPO data and a description of its methodology.

14. See, for instance, criticisms of service sector data in Kendrick [1986], Mohr and Christy [1986, p.217], Council of Economic Advisors [1988, pp.74-76]. A review of the literature did not even reveal any serious examination of the GPO manufacturing data.

15. Data on inventory levels and excise taxes are also used.

16. There are no adjustments to the petroleum refining industry, SIC 29, because BEA does not measure real value-added by double deflation in this sector. Rather, BEA uses an extrapolation method similar to that employed to measure many service industries (See Peterson [1987]).

17. The aggregate manufacturing adjustment is equal to the difference between published GPO less the unadjusted GPO for the manufacturing sector other than SIC 29. The adjustment factor is calculated directly from unpublished BEA GPO data.

18. Two percent is, of course, a very large shift given that manufacturing's share of GNP was about 22 percent in 1979.

19. See U.S. Department of Commerce [1977, Chapter 3], and Interindustry Economic Division [1984].

20. Another issue is that the basis for these adjustments is unknown. How was the size of the adjustment for particular industries determined? If there were large adjustments to manufacturing data what were the adjustments to the poorly measured service sector data?

21. In 1973 the primary metals industry had GPO of $57.8 billion (in $1982), NIPA, Table 6.2.

22. Each of the three measures of manufacturing output are directly drawn from the data used in the compilation of the GPO series. The unpublished BEA GPO data set has the following information for each manufacturing industry: current dollar data on shipments, inventories, excise taxes, and value-added; deflator indices (1982 = 100) for shipments, intermediates, GPO and the percentage amount of the adjustment; and constant dollar equivalents of the current dollar data plus published and unadjusted constant dollar value-added. Measures of gross output and input are calculated from these data. All the variables are summed to the manufacturing aggregate. The data cover the years 1972 to 1986 and include revisions of the published GPO series published in the SCB (July 1987). The unadjusted value-added series is based on an aggregation of unadjusted manufacturing data, excluding the unadjusted SIC 29 data, but adding the published SIC 29 data. Recall that GPO for SIC 29 is based on the extrapolation and not the double-deflation method so that the unadjusted values based on the double-deflation method available in the data set are

not meaningfully related to the final answer. The data cover the 1972-86 period. The paper primarily analyzes the 1973-85 period because 1973 was a cyclical peak and 1985 is the last year for which the GPO numbers are based on the Annual Survey of Manufacturers.

23. An examination of the annual changes in gross output and value-added reveals that intensity increased in every year since 1979, excepting 1982.

24. This drag can be seen by the negative 9 percent contribution of intensity to published GPO growth in the 1973-79 period.

25. The changing patterns over the business cycle since 1979 are also shown in Table 5. In the 1970s a fall in gross output was the primary reason for falling value-added in a recession, with rising gross output primarily responsible for creating value-added growth in the recovery, meaning that changes in intensity played only a minor role. In the recent recession, however, growing intensity cushioned the drop in value-added. In the current recovery, rising value-added intensity contributed more than a third of the growth in value-added.

26. The BLS multifactor productivity data for two-digit manufacturing industries yields information on constant dollar gross output and value-added as far back as 1949 [Gullickson and Harper, 1987]. These data show constant dollar gross output rising faster than constant dollar value-added in the period from (peak years) 1950 to 1959, 32.4 percent versus 30.0 percent. This implies that intensity fell in this period and that more than all of the value-added growth was due to gross output growth.

27. The ratio of constant dollar value-added to gross output in 1973, 1979, and 1985 was, respectively, 31.84%, 31.52% and 35.04%. Holding intensity at its 1979 value for each industry, the 1985 levels of gross output by industry imply an intensity of 32.26%. Therefore, of the total rise in intensity of 3.52 percentage points (35.04% - 31.52%) only 0.74 of it (32.26% - 31.52%) was due to a change in mix. In the 1973-79 period, the mix change led to a fall in intensity and there was no significant change in intensity within industries.

28. See Ott [1987, p.16], Kravis [1984, p.43], Krueger in U.S. Commerce Department [1986a, p.5], McUsic [1987, p.8] and McKenzie [1986, p.8] and [1987, p.9].

29. The data show the service input share of gross output rising from 9.0 percent in 1973 to 9.6 percent in 1979. A further rise to 10.3 percent in 1983 may be partially due to cyclical effects. For more information on this data series see Gullickson and Harper [1986 and 1987].

30. For instance, a 20 percent increase in the share of (current dollar) service input in gross output to 10.8 percent would only reduce current dollar value-added by 2.7 percent, so at first glance the magnitude of the potential effect of outsourcing to the service sector on value-added is small.

31. These assumptions obviously overstate the possible effect of service sector outsourcing since much of the increase in service inputs is due to the increased use of services such as computer programming and business consultants that were not previously in-house.

32. These calculations set the growth rate of the quantity of service inputs equal to that of material inputs starting in 1973. Current dollar service inputs are calculated using the service price index. New current dollar shares of all inputs are calculated and the difference between the hypothetical share of inputs and gross output is the labor and capital share. The calculation of constant dollar value-added follows the methodology spelled out in Technical Note #2.

33. Current dollar import data are drawn from unpublished tabulations from the International Trade Administration, U.S Department of Commerce, October 1987. Data on gross output are from the GPO series. Constant dollar imports are derived from implicit price deflators for nonpetroleum imports based on NIPA Tables 4.3 and 4.4.

34. The Federal Reserve Board [1986] notes this phenomenon on pp. 12 and 13. The data are from Table A.6 on p.172 and p.177.

35. Data are from the BLS Multifactor Productivity Data on two-digit Manufacturing Industries.

36. Energy prices are an exception.

37. Price measures are for nonpetroleum merchandise and for manufacturing gross output.

38. The description of the Producer Price Index in the forthcoming chapter for the new BLS Handbook of Methods says [p. 20], "the Producer Price Index does not measure changes in prices for imported goods." BLS [p.3] also states that "imports are no longer included within the PPI universe." The revision of the PPI, starting in 1978 and completed in January 1986, phased out import prices.

39. This is because manufacturing firms are more likely to have diversified out of manufacturing than service sector firms were to have added manufacturing activities. Therefore, some profits, depreciation, interest, and fringe benefits that belong to the service sector are being attributed to the manufacturing sector.

40. The Office of Technology Assessment [1988] of the U.S. Congress in a new study provides a more elaborate comparison of GPO trends to those derived from the I-O data.

41. See Grose [1970], U.S. Department of Commerce [1977], Interindustry Economic Division [1984] and Planting [1987].

42. Because the IPI series is more up to date than the GPO series the BLS actually substitutes IPI trends for GPO trends in quarterly analyses of manufacturing productivity changes.

43. Table 11 is based on: published manufacturing GPO data using a 1972 base from Table B-11 in the Economic Report of the President, 1984; published GPO in NIPA Table 6.2 for the data with a 1982 base; and hours data from NIPA, Table 6.11.

44. See Mohr and Christy [1986]. This is a conservative assumption since gross output has outpaced value-added growth throughout the post-war period.

45. The data for Estimate Four for the intervening years between 1972 and 1977, and between 1977 and 1981 are interpolated based on gross output trends.

46. Changes in manufacturing's share of national output are calculated by applying the output growth for each estimate to the published GPO in 1972 to derive an estimate of manufacturing GPO in 1973 and 1985 and then dividing by gross domestic product. The exception is Estimate 2 which uses the unadjusted manufacturing GPO in 1972 as a base.

47. These proportions are estimated using equation (13) in Costrell [1987] showing that the change in employment share is equal to the sum of natural log differences (between manufacturing and national) in output and productivity. Employment level data are from NIPA, Table 6.6A

Note that there are really only two numbers involved in this, as in other similar calculations -- output and employment. This follows from the fact that labor productivity is simply a measure of the change in output per employee input. This reinforces how critical one's assumptions about manufacturing output growth are to any analysis of the relative role of the output and productivity growth on employment trends.

48. The correction for industry mix allows value-added to grow 4.3 percent between 1979 and 1985, a growth equivalent to the 2.0 gross output growth plus growth due to the 2.3 percent increase (from 31.52 to 32.24 percent) in intensity due to the change in industry mix.

49. Fifty-two percent of the 3.7 percentage point decline in manufacturing's share of employment is 1.92 percent of employment, equivalent to 1.9 million jobs in 1985.

50. An overstatement of manufacturing productivity growth implies an understatement of nonmanufacturing productivity growth since the aggregate business sector productivity growth estimate is independent of estimates for particular sectors. As the recent Economic Report of the President [1988, p.75] acknowledges, "The quality of productivity measures in these [service] sectors does not necessarily affect the reliability of measures for the business sector as a whole. Business sector productivity is not a weighted average of productivity in each industry, but is the real value of the final goods, services, and structures produced per hour worked." Therefore, it is contradictory to maintain that service sector output or productivity has been seriously understated in recent years and that manufacturing's share of output has remained stable. An understatement of service output means that there is either an overstatement of another sector (unlikely to be construction) or some reason to suspect an understatement of business sector output. In either case, manufacturing's share of total output would fall. For recent examples of such contradictory positions see O'Neill [1987], and the Economic Report of the President [1988].

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APPENDICES

Appendix A: Quotes

This appendix presents a compilation of statements from economists who assert that "deindustrialization" is not occurring and that the manufacturing sector is healthy. The only statistical evidence used in each case is an analysis of the BEA constant dollar value-added series (the "Gross Product Originating" series) that this paper shows is an unreliable indicator of manufacturing trends.

Council of Economic Advisers, 1988 Economic Report of the President [1988]:

> "Except for business cycle movements, the share of real manufacturing output and real final goods output have been remarkably stable for 25 years....While manufacturing's share of employment has declined.... this trend does not suggest any long-term weakness in the manufacturing sector. Instead, it reflects stronger productivity growth in manufacturing than in other sectors of the economy."

Robert Z. Lawrence, Brookings Institution [1987]:

> "The estimate of manufacturing output in the GNP accounts shows America is not deindustrializing -- either over the long run (1960 to 1985) or the medium run (1980 to 1985). Real value-added in American manufacturing (measured in 1982 dollars) constituted 20.4 percent of GNP in 1980 and 21.7 percent of GNP in 1985. The volume of U.S. manufactured goods production has thus kept pace, almost exactly, with the overall production of goods and services (the GNP)....Faster productivity growth in goods production (rather than slower demand) is the source of the declining share of industrial employment in the economy."

Robert W. Crandall, Senior Fellow, Brookings Institution [1986]:

> "There is little basis for maintaining that the United States is deindustrializing, if one understands deindustrializing...to mean the relative decline of the industrial sector. The share of manufacturing and goods production in the United States has remained remarkably stable for decades."

Murray L. Weidenbaum, former Economic Advisor to Reagan: cited in by New York Times reporter Steven Greenhouse [1987]:

> Many economists say, however, that the deindustrialization process is a key reason the nation's goods producing employment fell to 25 million in 1986, from 26.5 million in 1979....Other economists, among them Murray L. Weidenbaum, former Chairman of the Council of Economic Advisors under President Reagan, dispute this view. They note that manufacturing output has remained near 21 percent of GNP for most of the post-war years, if figures are corrected for inflation. These analysts do not deny that many factories are closing, but they say new industries have replaced them.

Malcolm Baldridge, Former Secretary of Commerce, [1986, p.H3]:

> "We are not seeing a 'deindustrialization of America,' you know, in quotation marks like a lot of people talk about. That simply hasn't happened. What's happened is that American industry is beginning -- well, not only beginning, in a lot of cases has become -- competitive through new technologies. As a result, employment in manufacturing has gone down, but the manufacturing base itself hasn't been eroded.
>
> In 1960, manufacturing output as a share of GNP was 20 percent. In 1970 it was 21 percent, in 1980 it was 22 percent, in 1985 it was 21 percent. So it's stayed between 20 and 22 percent for 25 years. You can't call that a withering away of America's industrial base."

Paul R. Krugman, MIT, and **George N. Hatsopoulos** [1987,p.19]:

> "The third line of the table shows the share of manufacturing goods in output in constant dollars. This share was stable during the 1970s, indicating that the volume demand for overall manufactures grew as rapidly as overall demand. The declining share of manufactures in nominal GDP was thus entirely due to a lower rate of inflation in manufacturing than elsewhere resulting from the faster productivity growth in the manufacturing sector."

Gerald Moody, Office of Economic Analysis, Department of Commerce [1986, p.75]:

> "Expansion of the service industries has not led to 'deindustrialization' of the economy. Manufacturing's share of gross domestic product in constant dollars was not much lower in 1984 than it was in the 1950s."

John Cremeans, Director, Office of Business Analysis, U.S. Department of Commerce [1986, p.49 and 51]:

> "GPO (the BEA Gross Product Originating data) is a conceptually sound basis for the measurement of structural change because it contains no double counting and properly measures each industry's contribution to GNP...The GPO data show a detailed and accurate picture of the output of the U.S. economy.... Manufacturing is often referred to as a declining sector, but it is down [in 1984] only 1 point in GPO terms since 1948 and is actually about one-half share point higher in 1984 than it was in 1960. This would seem to support those who claim that the concern over the loss of "industrial strength" and the decline of the manufacturing is overstated.

Molly McUsic, Boston Federal Reserve Bank [1987, p.4]:

> "Output data provide no clear evidence that the United States is shifting to a service economy....Manufacturing industry output has remained a remarkably constant share of GNP, not fluctuating much beyond 20 to 22 percent of the total output since 1947.

Robert H. Schnorbus and **Alenka S. Griese**, Chicago Federal Reserve Board, [1987, p.3]:

> "In contrast, claims of deindustrialization for the nation as a whole, have been refuted by convincing research....For example, far from declining, manufacturing output nationally has been on a rising trend for many years. More importantly, manufacturing's share of gross national product (GNP) has been remarkably stable at roughly 25 percent over the post World War II era (allowing for deviations over the business cycle)."

Mack Ott, St. Louis Federal Reserve Board, [1987, pp 5-6]:

"Chart 1 shows that, while the services share of output has risen and, consequently, the commodities share has fallen, the share of the real GNP in the manufacturing output has remained virtually unchanged at roughly 21 percent. Consequently, the widespread perception of the U.S. deindustrialization is puzzling."

John A. Tatom, St. Louise Federal Reserve Board, [1986, p.17 and 22]:

"Chart 2 shows the share of manufacturing employment and output as percentages of civilian employment and real gross national product (GNP) respectively. The share of manufacturing output has fluctuated cyclically, but shows no trend. Employment in manufacturing has been declining as a share of total employment for a long time. The principle factor accounting for this decline has been relatively more rapid growth in labor productivity in manufacturing than in the remainder of the economy.

The view that foreign competition has led to relatively large losses in manufacturing employment in the 1980s is widely held. But there is no evidence above that the share of domestic manufacturing (chart 2) has been depressed by the appreciation of the dollar or by increased imports."

Dave **M. O'Neill**, Department of Commerce, Bureau of the Census, [1987, p.19]:

"Manufacturing's share of the nation's total output shows no sign of shrinking. There is a striking decline in this sector's share of U.S. jobs, but that reflects growing productivity."

Richard B. McKenzie, CATO Institute, [1986, p.9]:

> "Although manufacturing output has varied widely, along with general economic conditions, over the past several decades, the U.S. economy has hardly been deindustrializing in any meaningful sense. Adjusted for inflation, manufacturing output as a percentage of GNP has remained close to 23 percent for the past 40 years. Indeed, the economy has been <u>industrializing</u> in the sense that American industries have been relying more and more heavily on capital as a means of expanding their output. It has been deindustrializing only in the sense that industrial employment has fallen as a percentage of total employment, which signifies the attainment of an important goal of any economy and a mark of some distinction for a truly industrial society: getting a larger industrial output with fewer workers."

Ronald K. Shelp [1987]:

> "Has the service economy grown at the expense of manufacturing? Services have expanded at the time when manufacturing has been battered by an overvalued dollar....[U]ntil very recently, manufacturing had not really declined. Even with the overvalued dollar, manufacturing accounted for 21.7 percent of GNP in 1986, versus 21.4 percent in 1950."

Hobart Rowen, <u>Washington Post</u> columnist:

> "The fact that the U.S. industrial output has not declined as a share of the gross national product..."

Appendix B: Measuring GPO

This appendix presents the general methodology for constructing the GPO series. In the process, the relationship between current and constant dollar value-added and the relationship of value-added to gross output is clarified.

As stated earlier, value-added is the difference between gross outputs (shipments corrected for inventory changes) and consumed inputs:

$$(1)\quad VA = GO - I$$

where VA is value-added, GO is gross output, and I is intermediate inputs (the materials and services consumed in production).

Equation (1) is employed by BEA to measure the constant dollar value-added, or gross product originating, in particular sectors using the "double deflation" method as described in a Department of Commerce document:

> The current dollar values of industry product are obtained by summing the factor costs of production (compensation of employees, net profits, net rent, and net interest) and the nonfactor charges of production (indirect business taxes, capital consumption, etc.) However, as it is not possible to factor these components into quantities and unit prices directly, the constant dollar industry measures have generally been obtained by deflating separately industry outputs and industry purchases. The difference between the two deflated figures represents the gross product of each industry in constant dollars.

The double-deflation method is thus to deflate (i.e. convert to a constant dollar value) current dollar measures of gross output and inputs and subtract one from the other, as in equation (1), to derive a constant dollar value-added figure for an industry.

However, the GPO measure of constant dollar value-added is only theoretically based on value-added concepts because the necessary data are not available for most of the economy and for the service sector in particular. For instance, constant dollar output for one set of service sector industries is based on an estimate of value-added in a base year which is adjusted by extrapolating the current year values based on the changes in industry employment or real consumer purchases. Another set of service sector industries have their constant dollar output estimated by deflating the measure of current dollar value-added by the movement of wages since the base period. (BEA's description of the GPO methodology is reproduced at the end of this appendix.)

The only sectors where there is an attempt to measure constant dollar value-added by the preferred double-deflation method are manufacturing, construction, utilities, and railroads. Even here, it turns out, the GPO series does not have sufficient data because direct data on purchased inputs are not collected for the GPO series. This is discussed below. In any case,

movements of real value-added are usually presumed to be most accurately measured in manufacturing, the sector where the most data are available.

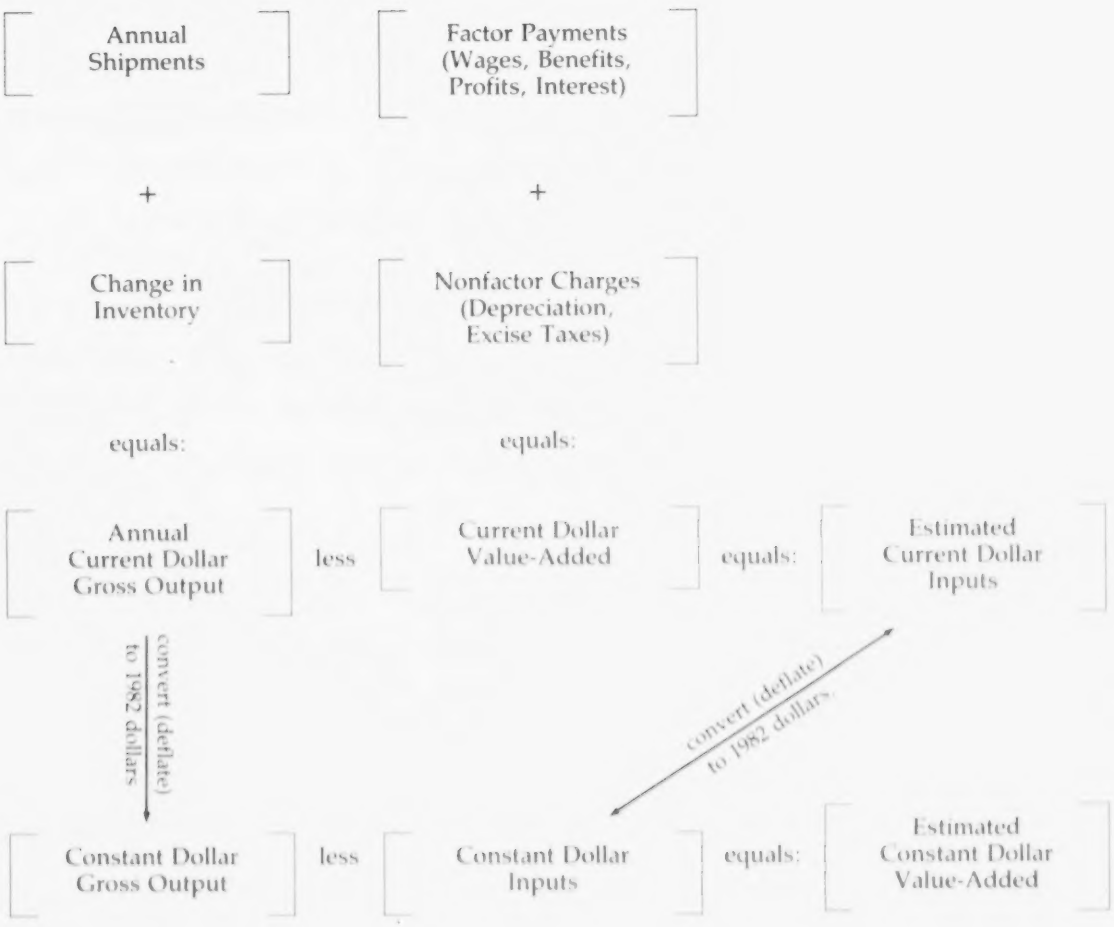
Before describing the actual measurement of constant dollar value-added, it is important to distinguish between the constant and current dollar measures of value-added by sector. Constant dollar value-added is not derived -- as is often supposed -- by deflating current dollar value-added with a price index (a single deflation method). Current dollar value-added is a measure of the factor incomes generated in a sector (the wages, fringes, interest, and profits) plus nonfactor charges of production (indirect business taxes and capital consumption allowances). It is developed by getting data on each source of income and charges, and distributing them to particular sectors. Thus, someone has to figure out how much of G.E.'s profits, depreciation and fringe benefit expenses came from particular sectors. Total current dollar value-added in each sector is measured by summing all of the components of value-added attributed to that sector.

The constant dollar series measures net output, as opposed to incomes. The measurement of manufacturing constant dollar value-added comes closest to actually employing equation (1), the double deflation method. However, as independent measures of inputs are not collected, inputs must be measured indirectly. The primary data relied on for the GPO series are measures of shipments (and inventory changes), current dollar value-added,

plus price indices for inputs and shipments. The measure of inputs is derived from these other data. The actual procedure (shown in the accompanying chart) is as follows (simplified by leaving out questions regarding excise taxes and inventories). Current dollar value-added (the factor and nonfactor incomes) of each sector (2 digit SIC) is subtracted from current dollar gross output to derive an estimate of current dollar inputs. Thus, equation (1) is available in current dollars. The current dollar gross output and the estimated inputs are then deflated using price indices to derive constant dollar gross output and inputs. Constant dollar value-added is thus available by subtracting constant dollar inputs from constant dollar gross output, as indicated by equation (1). This double-deflation method is not used, however, for the GPO estimates for one manufacturing industry, SIC 29, the petroleum refining industry. Rather, this industry's GPO is estimated based on an extrapolation of Department of Energy production data. (See BEA description of methodology.)

The published data on constant dollar value-added differ from that derived by equation (1) in one important way: the final data are adjusted before they are published. Some of these adjustments are understandable. For example, all of the data needed for the computation of GPO is not available on a timely basis. The 1986 GPO estimates, for instance, were constructed without full benefit of the major data source for manufacturing, the Bureau of Census' Annual Survey of

Constructing the GPO Estimates of Constant Dollar Value-Added in Each Manufacturing Industry



Manufactures. The 1985 GPO data does not yet benefit from important IRS data on profits. Thus, published constant dollar value-added figures for recent years incorporate analysts' judgments along with the available data.

But other adjustments are not so understandable. For instance, adjustments are made so that the GPO of all sectors adds up to the economy-wide measure of value-added, to reverse nonsensical results that arise from the data and for other unspecified reasons. BEA explanations of the construction of the GPO series make no mention of these adjustments nor the criteria for making them. These adjustments add a large subjective dimension to the GPO series and can be considered "fudge factor" adjustments.

The adjustments made to the data for some years are substantial. It is necessary, therefore, to isolate the effects of the adjustments on measured trends. In order to do so this paper distinguishes between the published GPO estimate, GPO^P, and the GPO estimates that are calculated directly from the data, GPO^U.

GNP by Industry: Summary of Sources and Methods

An industry's contribution to the Nation's output of goods and services as measured by GNP is called its gross product originating. An industry's gross product originating, or value added, may be defined in two equivalent ways. It equals the sum of the industry's factor payments and its nonfactor costs. It also equals the amount by which the total value of its output exceeds the value of its consumption of purchased materials and services.

BEA prepares annual estimates of gross product originating by industry in current and constant dollars. Preliminary estimates are usually published in the April SURVEY OF CURRENT BUSINESS, showing estimates for nine private industries (with manufacturing broken into durables and nondurables), government and government enterprises, and the rest of the world. Revised current- and constant-dollar estimates are usually published in the July SURVEY, in tables 6.1 and 6.2, respectively, with considerably more industry detail.

The current-dollar estimates are prepared as distributions by industry of the components of charges against GNP, the income-side total in the national income and product account (which differs from GNP by the statistical discrepancy). The classification underlying the distributions of private activities is based on the Standard Industrial Classification (SIC). The presently published estimates of gross product originating by industry are based, beginning in 1947, on the 1972 SIC.

The industrial distribution for private activities is largely based on data collected either from "establishments" or from "companies" (also called enterprises or firms). Establishments, as defined for the SIC, are economic units, generally at a single physical location, where business is conducted or where services or industrial operations are performed. Companies consist of one or more establishments owned by the same legal entity or group of affiliated entities. Establishments are classified into an SIC industry on the basis of their principal product or service, and companies are classified into an SIC industry on the basis of the principal SIC industry of all their establishments. Because large multiestablishment companies typically own establishments that are classified in different SIC industries, industrial distributions of the same item for establishments and companies can be significantly different.

The estimates of gross product originating by industry can be considered to be based on establishment data. For some components of charges against GNP, the source data provide establishment-industry distributions. For a number of other components, the source data—Internal Revenue Service tabulations of business tax returns—provide company-industry distributions. For the noncorporate parts of those components, BEA assumes that these distributions are equivalent to an establishment-industry distribution, because noncorporate businesses generally operate only one establishment. For the corporate parts except net interest, BEA has developed procedures to convert company-industry distributions to establishment-industry distributions. For corporate net interest, there is no adequate conceptual basis for the conversion, and conversion is not attempted. For the few components for which the source data do not provide either industry distribution, BEA has developed establishment-industry distributions from related sources. Table A shows the major source data for the aggregate estimates of each component of charges against GNP, whether the industrial distribution (if one is available) is of establishments or companies, and information about conversion to a distribution by establishment industry.

The constant-dollar estimates are prepared in one of three ways—double deflation, extrapolation, or direct deflation—depending on the availability of source data. In the double-deflation procedure, constant-dollar gross product originating is derived as the difference between constant-dollar gross output less constant-dollar consumption of intermediate materials and services. In the extrapolation procedure, constant-dollar gross product originating is derived by extrapolating the base-year value by an indicator series. Among the indicator series commonly used

Table A.—Major Sources for Current-Dollar Gross Product Originating by Industry

Component of charges against GNP	Major source data	Industrial distribution	
		Distribution available in source data	Data or assumption used if establishment-industry distribution is not available in source data
Compensation of employees:			
Wages and salaries	BLS tabulations of wages and salaries of employees covered by State unemployment insurance and Office of Personnel Management data on wages and salaries of Federal Government employees	Establishment	
Employer contributions for social insurance	Federal budget data	None	Social Security Administration and BLS tabulations
Other labor income	Trade association data and IRS tabulations of business tax returns	None	Census Bureau and IRS tabulations
Proprietors' income with inventory valuation adjustment:			
Farm	Department of Agriculture farm statistics	Establishment	
Nonfarm:			
Proprietors' income	IRS tabulations of business tax returns	Company	Assumed to be equivalent to an establishment-industry distribution
Inventory valuation adjustment	BLS prices and Census Bureau inventory data	Establishment	
Rental income of persons	Census Bureau American Housing Survey, BLS Consumer Expenditures Survey, and IRS tabulations of business and individual tax returns	Establishment	
Corporate profits with inventory valuation adjustment:			
Corporate profits before tax	IRS tabulations of business tax returns	Company	Census Bureau and Department of Energy data relating establishment-industry and company-industry data
Inventory valuation adjustment	BLS prices and Census Bureau inventory data	Establishment	
Net interest:			
Corporate	IRS tabulations of business tax returns	Company	None
Noncorporate	IRS tabulations of business tax returns	Company	Assumed to be equivalent to an establishment-industry distribution
Business transfer payments	IRS tabulations of business tax returns	None	Industry-specific payments are assigned to those industries; other are based on IRS industry distribution
Indirect business tax and nontax liability	Federal budget data and Census Bureau data on State and local governments	None	Industry-specific payments are assigned to those industries; property taxes are based on BEA capital stock distribution
Subsidies	Federal budget data and Census Bureau data on State and local governments	Establishment	
Current surplus of government enterprises			
Capital consumption allowances:			
Corporate	IRS tabulations of business tax returns	Company	Same as corporate profits before tax
Noncorporate	IRS tabulations of business tax returns	Company	Assumed to be equivalent to an establishment-industry basis

BLS Bureau of Labor Statistics
IRS Internal Revenue Service

are constant-dollar gross output, the quantity of goods or services sold, and the number of employees or hours worked. In the direct deflation procedure, constant-dollar gross product originating is derived by deflating the current-dollar value. Double deflation is the preferred procedure because both output and consumption are deflated using appropriate price indexes. The extrapolation procedure will yield the same results as double deflation when the rates of change in both constant-dollar gross output and consumption are the same. The direct deflation procedure will yield the correct constant-dollar measure when these rates of change are the same and when the deflator adequately represents changes in both output and purchases prices. Table B shows the procedures used for each industry.

Table B.—Methods for Estimating Constant-Dollar Gross Product Originating by Industry

Industry	Method	Major source data
Agriculture, forestry, and fisheries		
Farms	Double deflation	Department of Agriculture receipts, expenses, and prices.
Agricultural services, forestry, and fisheries	Extrapolation	BEA persons engaged in production and Department of Commerce pounds of fish caught.
Mining	Extrapolation	Federal Reserve Board index of production.
Construction	Double deflation	Census Bureau receipts, BEA expenses, and privately compiled and BLS prices.
Manufacturing, except petroleum and coal products	Double deflation	Census Bureau shipments, BEA input-output composition of consumption, and BLS prices.
Petroleum and coal products	Extrapolation	Department of Energy production.
Transportation:		
Railroad transportation	Double deflation	Privately compiled ton miles and expenses.
Local and interurban passenger transit	Extrapolation	Trade association passenger miles.
Trucking and warehousing	Direct deflation	Trade association dollars per ton miles.
Water transportation	Extrapolation	Census Bureau ton miles.
Transportation by air	Extrapolation	Department of Transportation passenger and freight ton miles.
Pipelines, except natural gas	Extrapolation	Trade association ton miles.
Transportation services	Extrapolation	BEA persons engaged in production.
Communication:		
Telephone and telegraph	Direct deflation	BLS prices weighted by Federal Communications Commission revenue and BLS average earnings.
Radio and television broadcasting	Direct deflation	BLS average earnings.
Electric, gas, and sanitary services	Double deflation	Department of Energy receipts and expenses and trade association prices.
Wholesale trade	Direct deflation	BLS prices weighted by Census Bureau margins.
Retail trade	Extrapolation	Census Bureau sales deflated by BEA.
Finance, insurance, and real estate:		
Banking	Extrapolation	BEA persons engaged in production.
Credit agencies other than banks	Extrapolation	BEA persons engaged in production.
Security and commodity brokers, and services	Extrapolation	BEA persons engaged in production.
Insurance carriers	Extrapolation	Trade association receipts and BLS prices.
Insurance agents and brokers, and services	Extrapolation	Trade association commissions and BLS prices.
Real estate	Extrapolation	BEA housing product.
Holding and other investment companies	Extrapolation	BEA persons engaged in production.
Services:		
Hotels and other lodging places	Extrapolation	BEA constant-dollar PCE for hotels.
Personal services	Extrapolation	BEA constant-dollar PCE for personal services.
Business services	Extrapolation	BEA persons engaged in production.
Auto repair, services, and garages	Direct deflation	BLS prices.
Miscellaneous repair services	Extrapolation	BEA persons engaged in production.
Motion pictures	Direct deflation	BLS prices and wage rates.
Amusement and recreation services	Direct deflation	BEA implicit price deflator for PCE recreation services.
Health services	Extrapolation	BEA constant-dollar PCE for medical care.
Legal services	Extrapolation	BEA constant-dollar PCE for legal services.
Educational services	Extrapolation	BEA persons engaged in production.
Social services and membership organizations	Direct deflation	BLS average earnings.
Miscellaneous professional services	Direct deflation	BLS average earnings.
Private households	Extrapolation	BLS hours worked.
Government and government enterprises:		
Government:		
Government enterprises:	Extrapolation	BEA hours worked weighted by BEA measures of experience and education.
Federal	Extrapolation	BEA hours worked and BLS output indexes.
State and local	Extrapolation	BEA hours worked.
Rest of the world	Direct deflation	BEA implicit price deflator for net domestic product.

BEA Bureau of Economic Analysis
BLS Bureau of Labor Statistics
PCE Personal consumption expenditures

Source: Peterson, Milo. "Gross Product By Industry, 1986," Survey of Current Business (April 1987): 25-27.

Appendix C: Measurement Problems

This appendix describes measurement problems in the GPO series that may be responsible for falsely finding rising value-added intensity.

The primary measurement problems leading to increased intensity involve current dollar inputs or input price deflators. This follows from the fact that the various data series exhibit a rough consensus on the movement of current and constant dollar gross output. If gross output trends are properly measured then value-added trends can only be overstated if the growth of constant dollar inputs is understated. An understatement of input growth may result from an overstatement of input price increases or from an understatement of current dollar input increases. Because current dollar inputs are measured in the GPO series indirectly (by subtracting current dollar value-added from current dollar gross output), any <u>overstatement</u> of the current dollar value-added in manufacturing will cause current dollar inputs to be <u>understated</u>. Our prime culprits, according to this logic, have to be measurement problems which overstate current dollar value-added or lead to an overstatement of input price increases. Since the rise in intensity has occurred since 1979, any alleged mismeasurement problem must also have increased since that time or it could not have contributed to falsely finding rising intensity.

(i) Current Dollar Value-Added and Inputs

There are a number of areas where current dollar value-added in manufacturing may be overstated, thus creating an understatement of current dollar input growth. Recall that current dollar value-added is the sum of the factor payments (wages, profits, interest) and nonfactor charges (excise taxes and depreciation). The culprit to be found must be one where these factor or nonfactor charges are attributed to manufacturing but more properly should be to attributed to other sectors.

The components of current dollar value-added are attributed to particular industries in two ways. Some data, such as wages and salaries, are collected on an establishment (or facility) basis such that the industry to which that establishment belongs is readily identifiable. Therefore, it is unlikely that there are large errors in attributing wage and salaries and other establishment based data to manufacturing versus other sectors.

There is more room for error in the other method of attributing data. Profits, fringe benefits, interest, and depreciation data are only available on a company or enterprise basis. As a result, BEA must determine how much of a company's profits, depreciation, net interest costs, and fringe benefits are attributable to that company's production activity in particular industries. BEA does not attempt any industry allocation of interest costs; rather, BEA assigns the interest costs to a company's primary industry. The accuracy of the distribution of these items to manufacturing versus other sectors

thus depends on the accuracy of the company-industry links on which BEA relies. Some of these links rely on data from as far back as 1972. Since that time there has been substantial conglomeration and diversification, increased corporate debt and an increase in fringe benefits relative to wages, all factors which would exacerbate any measurement difficulties in attributing profits, interest, depreciation, and fringe benefits to particular industries. The difficulties in allocating these items to particular industries can be seen in BEA's handling of interest expenses, which it does not even attempt to allocate to other than a firm's primary industry. That these difficulties might be leading to a significant understatement of manufacturing input growth was suggested by the comparison of the GPO data to the I-O data. In the 1977 to 1981 period the I-O data shows current dollar inputs growing 10 percent faster that the GPO data show. The other side of this comparison is that GPO current dollar value-added grew 23 percent faster than the comparable I-O data.

The problem with the BEA current dollar input data, therefore, is that they are measured indirectly. As a result, BEA's inability to adjust the distribution of current dollar value-added across industries according to an updated measure of corporate structure may lead to an understatement of manufacturing input growth.

(ii) Input Prices

There are reasons to suspect an overstatement of recent input price inflation. The problem in this area is that the Produce Price Indices currently used to create output and input price indices reflect domestic prices only. This limitation is not a problem for gross output deflators since these price indices should measure the price of goods leaving domestic establishments. However, the proper price index for inputs should reflect the inputs actually consumed, both domestic and imported. If imported input price increases had been incorporated into the input price deflators then measured input inflation would have been lower. This result can be expected for two reasons. One is that imported inputs will be either less expensive or of better quality, or both. Because imported inputs have been increasing as a share of total inputs since 1979 their inclusion would have dampened the measured price increases.

The other reason is that the increased strength of the dollar over the 1979-85 period caused prices of imports to rise less than domestically produced goods. So, even if the input share had not increased, a rising dollar would have reduced input price inflation relative to a measure which relies solely on domestically produced inputs.

This measurement error is compounded by the fact that the Producer Price Indices previously did incorporate some import prices. However, import prices have been gradually removed from

the data starting in 1978. This change in method exacerbates the measurement problem in the period since 1978.

The failure to incorporate prices of imported inputs into input price deflators introduces a systematic bias to understate constant dollar input growth which, in turn, overstates the growth of constant dollar value-added. This bias will be especially pronounced in times characterized, as the 1979 to 1985 period was, by rising imports and a rising dollar.

The input price measurement problems are illustrated in Table C-1 which shows the measurement of constant dollar value-added under various scenarios. The base period (column 1) represents a purely domestic economy where no imports are used to manufacture goods. This situation is compared (in columns (2) and (3)) to one in which 10 percent of the inputs are purchased abroad at a price 20 percent less than comparable domestic products ($0.56 versus $0.70). Columns (2) and (3) differ only in the measurement of the input price deflator; column (2) illustrates the mismeasurement where there is no detection that input prices have declined by 2 percent on average (the input deflator stands at $1.00 as if all inputs still cost $0.70) whereas column (3) accurately captures the fall in input prices. When input price changes are properly measured, as in column (3), there is no measured change in constant dollar value-added (see line 16) when the import share of inputs increases (relative to the base period). Column (4) illustrates the measurement problem that occurs when relative import prices fall (perhaps due to a

Table C-1: Input Prices, Imports, and Mismeasurement

Situation	(1) Base Period	(2) Mismeasured	(3) Correctly Measured	(4) Mismeasured	(5) Correctly Measured
	Import share: 0%	Import Share: 10% Import Price Discount: 20%		Import Share: 10% Import Price	Discount: 30%
Gross Output					
1. Quantity	5	5	5	5	5
2. Price	$2	$2	$2	$2	$2
3. Currert Dollar Value (1 X 2)	$10	$10	$10	$10	$10
Input					
4. Quantity (5 + 6)	10	10	10	10	10
5. Domestic	10	9	9	9	9
6. Imported	0	1	1	1	1
7. Price					
8. Domestic	$.70	$.70	$.70	$.70	$.70
9. Imported	-	$.56	$.56	$.49	$.49
10. Current Dollar Value (5X8+6X9)	$7.0	$6.86	$6.86	$6.79	$6.79
Value-Added					
11. Current Dollar Value (3 - 10)	$3.0	$3.14	$3.14	$3.21	$3.21
Price Deflators (Base = 1.00)					
12. Gross Output	1.00	1.00	1.00	1.00	$1.00
13. Input	1.00	1.00	0.98	1.00	$1.00
Constant Dollar					
14. Gross Output (3/12)	$10	$10	$10	$10	$10
15. Input(10/13)	$7.0	$6.86	$7.0	$6.79	$7
16. Value-Added (14 - 15)	$3.0	$3.14	$3.0	$3.21	$3
17. Intensity (16/14)	30%	31.4%	30%	32.1%	30%

stronger dollar), assuming the import share remains at 10 percent. If only domestic input prices are captured in the input price index, as in column (4), a relative fall in import prices leads to a false finding of higher constant dollar value-added (see line 16), to $3.21 from $3.00. When import prices are reflected in the price index, as in column (5), there is no mismeasurement when there is a relative fall in import prices.

These examples illustrate that when either import penetration is rising or relative import prices are falling there will be a systematic overstatement of constant dollar value-added when, as is the case with the GPO series, input price deflators reflect domestic prices only.

Appendix D

a. Data Sources

This appendix presents a comparison of the GPO data to other data on manufacturing. The primary data series to which the GPO series data on gross output, value-added, and inputs can be compared is that from the BEA Input-Output (I-O) tables. The BLS Time Series (TS) data provides another comparison, but only for gross output. A third data series, the Federal Reserve Production Index (IPI), provides another point of comparison even though the IPI concept of production does not directly match either the concept of gross output or of value-added.

Data from the BEA I-O tables are the most comprehensive, complete and reliable information available on particular industrial sectors. These data are primarily based on the detailed industry statistics provided in the economic censuses conducted every five years. "Full" I-O tables, therefore, are only available every five years, the last ones available being for 1972 and 1977. BEA has also issued an interim, updated I-O table for 1981. The advantages of the I-O tables are their completeness and accuracy since they incorporate all of the available information for a particular year. The disadvantages of the I-O data for comparison purposes are that only current dollar information on gross output, value-added, and inputs are available and that relatively recent information is not available.

It is possible to construct a constant dollar value-added series using the BEA I-O data by deflating two-digit manufacturing I-O current dollar gross output and input data by the gross output and input deflators employed in the GPO series. This method provides constant dollar ($1982) value added in 1972, 1977, and 1981 for all 21 manufacturing industries. These data, in turn, are aggregated to the manufacturing level.

The IPI series focuses on measuring changes in the quantity of gross output in disaggregated manufacturing industries. The Federal Reserve Board [1986, p.21] notes that "the emphasis on the movements of physical output also creates some problems, particularly in comparisons of the index with other ways of estimating output." Comparison of the IPI series to other series is also confounded by the fact that the aggregate index for manufacturing is a curious mix of value-added and gross output. This mix results from aggregating production trends of particular industries to the manufacturing level through a current dollar value-added weighting scheme. Consequently, the IPI series does not provide a direct comparison to either gross output or value-added measure of output. Comparisons using the IPI series are presented after comparisons with the other data series are reviewed.

The other data set, the BLS Time Series Data on Gross Output provides a point of comparison to the GPO data on gross output. Unfortunately, this data series does not provide any measure of value-added or inputs.

An issue that must be confronted when comparing the GPO series to others is how the adjustments should be treated. That is, trends in gross output and inputs can be identical in two series but the resulting constant dollar value-added series will differ because of the GPO adjustments. In the following discussion, comparisons are made to both the GPO-unadjusted and GPO-published series. The adjustments have been incorporated into the GPO-published series by modifying the current dollar inputs and value-added series. This procedure was selected because there is relatively little disagreement among the various data series on the movement of current dollar shipments. It is thus assumed that any adjustments to the unadjusted-GPO data takes the form of increasing or reducing the growth of current dollar purchased inputs, with consequent implications for current dollar value-added.

The GPO-unadjusted trends used for comparison purposes are derived from the underlying input, value-added, and gross output data using the input and output price deflators employed by BEA in the construction of the GPO series. This unadjusted series incorporates the published values of SIC 29 since this industry is not double-deflated and has not been adjusted.

b. Sensitivities

Tables D-1, D-2, and D-3 present the available data comparisons. One very important point to extract from these tables is the sensitivity of value-added estimates to differences

in the measurement of price or current dollar trends. This sensitivity can be seen in the differences between I-O and GPO trends for 1977-81 shown in Table D-1. Inputs grew 5.0 percentage points (or 9.7 percent) faster in the I-O data than in the GPO-published series. The consequence for value-added is a 7.8 percentage point gap (41.6% versus 33.8%) in growth in this period, with value-added in the published GPO series rising 23 percent faster. The implications for a constant dollar value-added series are sizeable. As shown in Table D-3, if the gross output and input deflators used in the GPO series are applied to the I-O data for the 1977-81 period, constant dollar value-added falls 1.0 percent, a substantially different result than the 4.8 percent rise in the GPO-published series. These sensitivities are greatest over short time periods, especially when dealing with constant dollar trends.

The reason for the sensitivity of current dollar value-added estimates to seemingly small changes in the measurement of input growth is that inputs comprise the largest share of total gross output. The share of inputs to total gross output in the I-O manufacturing data for 1977, for instance, was 64.0 percent. As value-added is a residual and is a smaller share of gross output, any differences in measured input growth imply a larger (roughly double) percentage change in value-added.

This sensitivity suggests that even if the input measurement problems discussed in Appendix C are relatively small they may still lead to large measurement errors in constant dollar value-added trends.

c. Specific Comparisons: Value-Added, Gross Output, and Inputs

As mentioned earlier, the various data series show the most agreement when it comes to current dollar gross output trends. This consensus on gross output trends in Tables D-1 and D-2 hold true for both current and constant dollar trends.

It is important analysis to compare GPO constant dollar value-added trends to comparable independent estimates. The bad news is that there is only one comparison available -- to the I-O data. The good news is that the I-O data are very credible.

The comparison of constant dollar value-added trends in the I-O and the GPO series is shown in Table D-3. Because the constant dollar value-added estimates from the I-O data employ the actual GPO price indices, any differences between them must be due to differences in current dollar trends and to the GPO adjustments. Current dollar comparisons in Table D-1 show a rough agreement on trends between the 1972 and 1977 benchmark years, but a sizeable diversion thereafter. As discussed earlier, the I-O data show a much slower growth of current dollar value-added from 1977-81 than the GPO-published series shows. As Table D-3 shows, even close agreement on current dollar trends in the 1972-77 period yields noticeable differences in manufacturing

Table D-1: Comparison of GPO and I-O Manufacturing Current Dollar Trends, 1972 - 1981

	BEA		
	GPO unadj.	GPO publ.	I-O
1972-77			
GO	78.8%	78.8%	78.0%
VA	59.7	67.5	66.1
Inputs	90.5	85.2	85.6
1977-81			
GO	48.3%	48.3%	48.5%
VA	37.4	41.6	33.8
Inputs	54.0	51.8	56.8
1972-81			
GO	165.1%	165.1%	164.4%
VA	119.5	137.2	122.2
Inputs	193.3	181.1	190.8

Table D-2: Comparison of GPO and TS Gross Output Trends, 1973-85

	BEA GPO Series Gross Output	BLS Time Series Gross Output
1973-79		
Current Dollar	96.1%	97.6%
Constant Dollar	13.3	13.8
1979-85		
Current Dollar	31.4%	31.3%
Constant Dollar	2.0	2.1
1973-85		
Current Dollar	157.6%	158.9%
Constant Dollar	15.6	16.2

Table D-3: Comparison of Estimated Input-Output Constant Dollar Value-Added and Constant Dollar GPO Trends

Data Series	1972-77	1977-81	1972-81
		All Manufacturing	
Input-Output(est)*	12.7%	-1.0%	11.8%
GPO-Published	14.9	4.8	20.5
GPO Unadjusted	8.6	2.1	10.9
		Manufacturing, Exc. SIC 29	
Input-Output(est)*	13.1%	-1.4%	11.6%
GPO-Published	14.8	5.6	21.2
GPO Unadjusted	8.2	2.7	11.2

* Constant dollar value-added computed at the two-digit level using GPO price indices and I-O current dollar input and gross output data.

constant dollar value-added trends, a 14.9 rise in the published GPO series versus a 12.7 percent rise in the I-O series. The I-O estimate for the 1972-77 period runs closer to the GPO published trend than the unadjusted trend. This is because there are significant adjustments in the published series at both endpoints, 1972 and 1977. It is when one year is adjusted and the other is not that the published-GPO trends vastly overstate output growth.

The differences between the constant dollar value added I-O and GPO series in the 1977-81 period are stark and very troublesome. The I-O series shows a 1.0 percent decline in manufacturing value-added, compared to a 4.8 percent increase in the GPO published series. Note that these differences arise

primarily because of the faster growth of current dollar inputs in the I-O series because the same price deflators are being used in the comparison and the I-O data actually show a slightly faster growth of current dollar shipments (see Table D-1).

The differences are extreme when the I-O and GPO series are compared over the entire 1972-81 period. The I-O data show a growth of constant dollar manufacturing value-added of 11.8 percent, an estimate roughly that of the unadjusted GPO series estimate of 11.9 percent, but 42 percent less than the published GPO estimate of 20.5 percent. These results indicate that the published GPO series substantially overstates constant dollar value-added growth. Moreover, these comparisons show that the GPO published series has not been "benchmarked" to the interim I-O tables for 1981. These conclusions are confirmed by the trends in the non-oil manufacturing sector shown in the bottom panel of Table D-3 (covering the sector that was adjusted).

Measurement of input trends in the various data series are quite varied. There is close agreement between the GPO published series and the I-O data between the benchmark years 1972 and 1977, as one would expect. However, as discussed earlier, the differences from 1977 to 1981 are significant, especially for the consequences for value-added. Surprisingly, the unadjusted GPO series input trend differs from that of the I-O series for the 1972-77 period, although there is agreement over the entire 1972-81 period.

d. The GPO and the IPI series

The IPI series is the most publicized indicator of industrial and manufacturing production and is frequently compared to the GPO numbers. Because the IPI concept of manufacturing production is primarily based on physical changes in output comparable to that measured by gross output, the most appropriate comparisons are to the GPO measure of constant dollar gross output in Table D-4. A comparison of IPI trends to those of the GPO constant dollar value-added series is presented in Table D-5. These tables provide comparisons for the two recent peak-to-peak period and for the recent recovery for each two-digit manufacturing industry.

The data in Table D-6 compare aggregate manufacturing trends of the GPO series and of the IPI series. Gross output trends are presented in two ways. The "direct aggregation" method is based on the changes in the sum of the gross output of each two-digit manufacturing industry. The "weighted aggregation" method uses the IPI (value-added based) weights for each two-digit industry to aggregate GPO gross output trends. This method permits an examination of the differences between gross output and IPI trends that are not due to the weighting scheme, at least at the two-digit level.

IPI trends consistently exceed gross output trends. In the earliest period the IPI series grew 44 percent faster than gross output (18.6 versus 12.9 percent). Since 1979 IPI growth has

Table D-4: Comparison of Gross Output and Industrial Production Index Growth in Manufacturing Industries, 1973 - 1985*

SIC	1973 to 1979 (1) Gross Output (GO)	(2) Ind. Prod. (IPI)	(3) Ratio (GO/IPI)	1979 to 1985 (4) Gross Output (GO)	(5) Ind. Prod. (IPI)	(6) Ratio (GO/IPI)	1982 to 1985 (7) Gross Output (GO)	(8) Ind. Prod. (IPI)	(9) Ratio (GO/IPI)
	(Percent Change)								
20	14.1%	18.8%	75%	9.8%	22.0%	44%	4.2%	13.3%	32%
21	-2.8	4.8	-59	-7.0	-4.1	169	-9.9	-4.5	220
22	9.7	6.7	143	-5.7	-1.1	499	8.1	15.7	52
23	2.3	10.4	22	4.8	2.6	183	2.4	15.6	16
24	5.5	6.7	82	1.3	11.2	12	17.2	37.0	47
25	5.5	11.1	49	9.1	25.1	36	18.3	33.7	54
26	10.9	12.6	87	7.8	15.2	51	10.2	16.6	61
27	13.6	24.4	56	21.9	36.6	60	13.3	28.0	47
28	17.5	26.9	65	-3.0	14.1	-21	10.2	22.4	45
29	39.1	11.1	351	-15.4	-14.7	105	1.0	3.1	31
30	5.8	33.1	17	19.5	27.9	70	25.4	33.3	76
31	-15.0	-12.2	123	-20.2	-28.0	72	-17.1	-16.1	106
32	5.1	16.1	32	-13.1	4.0	-330	13.5	29.5	46
33	-6.7	-5.1	132	-33.9	-25.8	131	3.1	22.3	14
34	4.6	10.1	45	-5.3	-1.9	275	12.9	23.9	54
35	18.5	33.7	55	23.8	18.5	128	38.3	25.7	149
36	25.8	38.6	67	24.8	34.0	73	22.0	31.2	70
371	6.4	6.8	94	.6	16.3	4	59.2	66.9	88
375	16.8	9.1	185	5.5	7.8	70	12.9	16.6	78
38	41.9	46.7	90	18.7	17.2	109	12.5	11.0	114
39	-1.9	8.5	-23	-11.5	-4.9	237	-4.7	6.8	-69
ALL	13.3	18.6	72	2.0	13.4	15	14.8	23.7	62

* Gross output trends calculated from unpublished BEA data. Industrial production trends calculated from Federal Reserve Board Industrial Production Indices.

Table D-5: Comparison of Constant Dollar Value-Added and Industrial Production Index Growth in Manufacturing Industries, 1973 - 1985*

SIC	1973 to 1979 (1) Value Added (VA)	(2) Ind. Prod. (IPI)	(3) Ratio (VA/IPI)	1979 to 1985 (4) Value Added (VA)	(5) Ind. Prod. (IPI)	(6) Ratio (VA/IPI)	1982 to 1985 (7) Value Added (VA)	(8) Ind. Prod. (IPI)	(9) Ratio (VA/IPI)
	(Percent Change)								
20	5.2%	18.8%	28%	14.6%	22.0%	66%	2.4%	13.3%	18%
21	3.5	4.8	73	-26.1	-4.1	634	-18.3	-4.5	409
22	27.1	6.7	402	-1.9	-1.1	168	6.3	15.7	40
23	9.6	10.4	92	-.2	2.6	-6	3.4	15.6	22
24	17.9	6.7	267	-2.5	11.2	-22	27.6	37.0	75
25	11.7	11.1	105	6.9	25.1	27	21.1	33.7	63
26	7.9	12.6	62	13.1	15.2	87	14.6	16.6	88
27	11.7	24.4	48	13.3	36.6	36	11.0	28.0	39
28	24.1	26.9	90	1.9	14.1	14	2.1	22.4	9
29	12.2	11.1	109	-13.8	-14.7	94	2.2	3.1	71
30	10.0	33.1	30	25.9	27.9	93	30.4	33.3	91
31	-11.1	-12.2	91	-13.2	-28.0	47	-8.7	-16.1	54
32	6.3	16.1	39	-5.0	4.0	-126	22.1	29.5	75
33	-14.0	-5.1	275	-31.5	-25.8	122	-3.4	22.3	-15
34	5.5	10.1	55	1.5	-1.9	-80	20.5	23.9	86
35	22.0	33.7	65	64.1	18.5	346	71.8	25.7	279
36	37.2	38.6	96	39.2	34.0	115	35.6	31.2	114
371	7.6	6.8	112	-.5	16.3	-3	62.0	66.9	93
375	10.9	9.1	120	21.8	7.8	279	40.7	16.6	245
38	46.5	46.7	100	25.8	17.2	150	25.0	11.0	227
39	3.9	8.5	46	22.4	-4.9	-462	33.2	6.8	489
ALL	12.2	18.6	66	13.4	13.4	100	24.5	23.7	103

* Constant dollar value-added trends calculated from published GPO series. Industrial production trends calculated from Federal Reserve Board Industrial Production Indices.

D-6: Trends in Manufacturing Gross Output and Industrial Production

Gross Output	1973-79	1979-85	1982-85
(1) Direct Aggregation	13.3%	2.0%	14.8%
(2) Weighted Aggregation	12.9	4.9	16.8
Industrial Prod. Index	18.6	13.4	23.7

exceeded gross output growth by nearly seven times. Even after accounting for the differences in weighting schemes (i.e., by comparing the weighted gross output to the IPI series) there is still a large gap between the trends in the two series.

The industry by industry comparisons in Table D-4 show that the gaps between these series at the industry level are even larger than the aggregate, or average, difference suggests.

The differences between the gross output and IPI series are especially disturbing because the IPI series is supposedly benchmarked to gross output data in the Annual Survey of Manufacturers. These differences are also longstanding. Miron and Zeldes [1987, Tables A1a and A1b] show that aggregate manufacturing IPI growth exceeded gross output growth by 32 to 58 percent from 1967 through 1985. They also found extreme differences at the industry level.

On the surface, the IPI series accords with the GPO constant dollar value-added series for the recent period, each rising 13.4 percent from 1979 to 1985. The industry by industry comparisons

in Table D-5 show that this apparent agreement is purely accidental because the two series rarely agree at the industry level. The industry growth rates of the two series are only within 25 percent of each other (plus or minus) in seven of the twenty-one manufacturing industries. Consequently, neither series reflects well on each other. The fact that the IPI series in the aggregate has the same 1979 to 1985 trend as the GPO series hardly lends credibility to the GPO series.

Data Assessment

What light do all of these comparisons shed on the GPO series? The I-O series tells us that between the benchmark years of 1972 and 1977 the GPO published series is somewhat comparable to the I-O series. For the 1977 to 1981 period, however, there are marked differences in current dollar value-added growth, with the GPO published series showing 23 percent greater growth. This difference implies an estimated fall in constant dollar value-added of 1.0 percent in the I-O data versus a GPO rise of 4.8 percent in the 1977-81 period. This evidence suggests that the GPO series may be substantially revised when it is benchmarked to the 1982 I-O table when it becomes available in 1989, and thus the present estimates do not deserve our confidence. Because of the time lags in data collection, data on the current period (1987) will not be benchmarked until 1995 or 1996. The large revisions that will probably be made to the 1982 GPO estimate, however, do not inspire confidence in the recent GPO estimates.

Given the divergence of the post-1977 GPO data from the I-O data and the divergence of the GPO gross output and value-added data these recent data do not deserve our confidence.

On the surface, the IPI series supports the GPO series. This agreement breaks down at the industry level where the two series are rarely even in rough agreement.

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